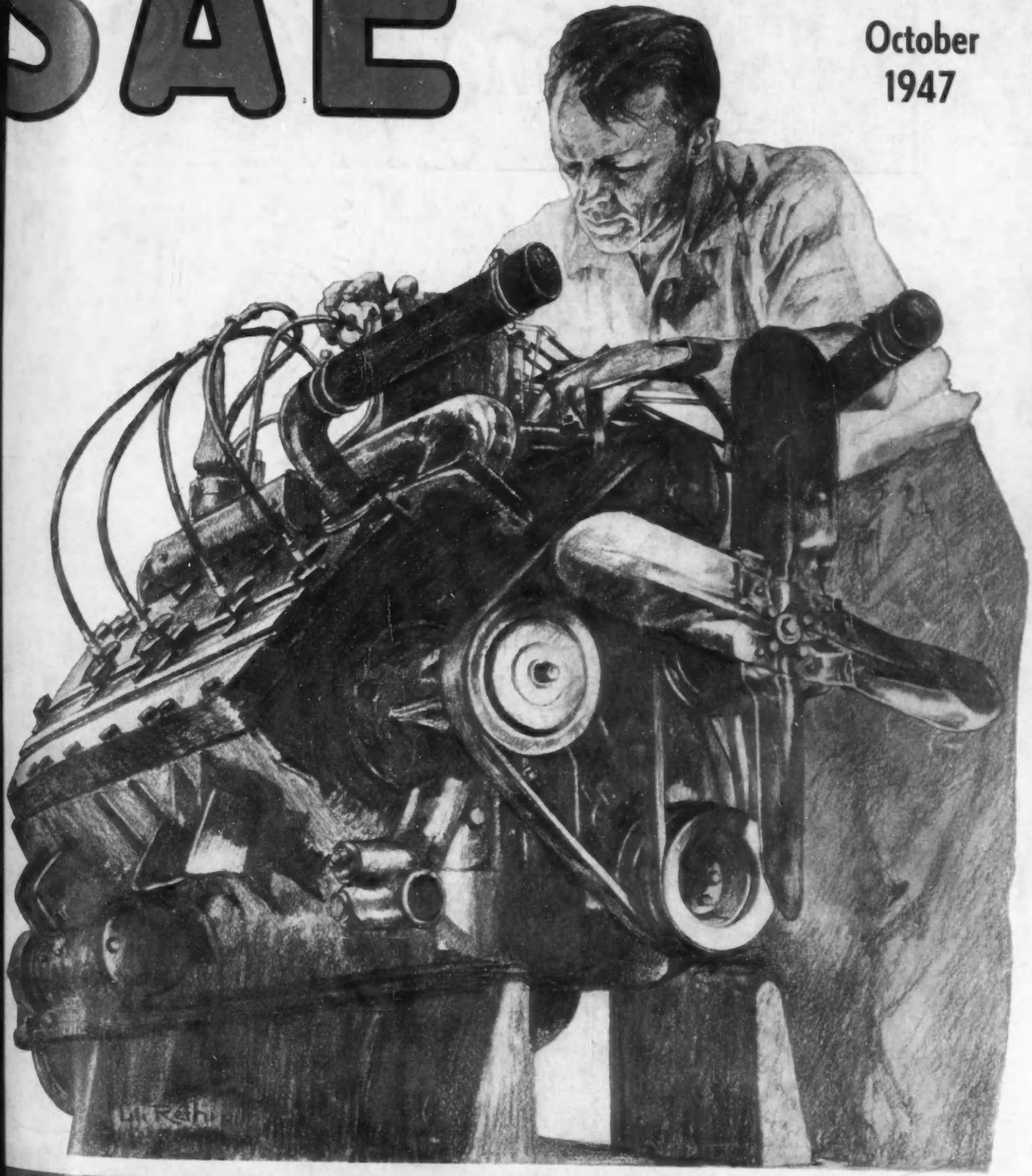
EERING
RARY

OCT 14 1947

SAE JOURNAL

October
1947



In this issue: National West Coast T&M Meeting . . . Valve Trends . . . Cylinder Wear . . . Trim Materials . . . Dynamometer Testing . . . Slant-Mechanism Barrel Engine . . . Fleet Operation . . . Chrome Plating in Fleets . . . "What a Young Engineer Should Know"

Rumor Page

IT'S RUMORED THAT

Roadside advertising in red is forbidden in some states.

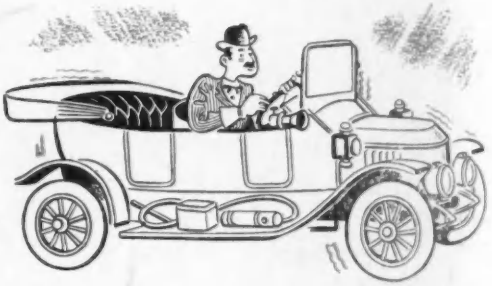
That's right. In some states where warning signs are red, the use of red in roadside advertising is against the law for fear of confusion. Incidentally, most states use black and yellow signs. Tests conducted at Northwestern University proved that black and yellow are most vivid for most people.

IT'S RUMORED THAT

The Stanley Steamer Company, ex-manufacturer of automobiles, would give one of their cars free to anyone who would run it wide open for one minute!

Not so, says Mr. R. W. Stanley. The old Stanley Steamer would hit speeds up to about 127.659 and was opened up wide several times at Daytona Beach in the old days. Too bad. It might be a way to beat the car shortage.

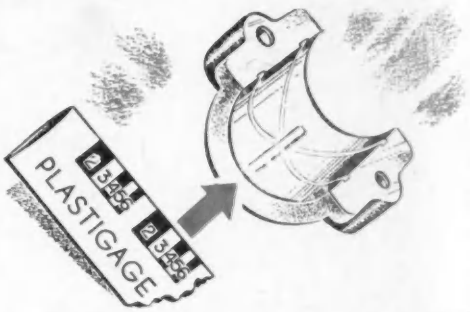
—Contributed by George J. Barna
Kenmore, New York



IT'S RUMORED THAT

A new product,* Plastigage, *made by* Perfect Circle, *saves up to ⅔ time in checking bearing clearances.

Right! Simply cut off a section of *Plastigage* in its envelope container. Remove bearing cap, lay *Plastigage* section in it, replace cap and tighten. Match up flattened *Plastigage* with envelope marks and the width thus matched reads in thousandths of clearance. Simple, fast, foolproof, *and inexpensive.*



IT'S RUMORED THAT

Perfect Circle engineers were the first to develop the individual casting technique for piston rings.

This one is true. Perfect Circle was the first to cast piston rings individually, and on that technique is based all of the individual characteristic developments now taken as standard for the industry.

Perfect Circle Corporation, makers of Perfect Circle *Custom Made* Piston Ring Sets, will pay fifty dollars ($50) for each rumor, fact or fiction, accepted for this page. Send your rumor to Rumor Page, Perfect Circle, Hagerstown 9, Indiana. All contributions become our property and cannot be returned or acknowledged.

The Cover

• Final assembly of an engine on the production line calls for skilled men to assure proper adjustment of working parts and accessories before the powerplant is lowered on the chassis on the automobile production line. This view, taken near the off end of a long line of engines getting their finishing touches, is typical of the mass production techniques which have made the industry one of the world's largest.

For the Sake of Argument

By NORMAN G. SHIDLE

Trouble with most writers of engineering papers is too much concern with what goes into the paper and not enough with what the audience is going to get out . . .Too much concentration on the writer's problems; not enough on those of the listeners.

First step in writing a paper should be hard thinking about interests of the probable audience. A paper on "What's Ahead in Automobile Design" which rings the bell before Detroit engineers may readily bore a group of technicians assembled in Montreal, Canada — even though both groups *could* be interested in the same topic.

The means by which the audience is going to receive (by eye or ear) is a factor, too. A good oral presentation usually appears wordy, loose in sentence structure, when printed. A tightly-reasoned, full-of-facts paper may read well and be thoroughly dull if presented exactly as written.

Engineers often are willing to let audiences worry along with something less than the best in presentation. Chief reason is the hard work involved. Most "perfect" presentations represent complete "presentation" re-writing after the material has been put together in reasonably logical form. By that time, most authors say: "I can't be bothered further."

No amount of writing or editorial skill can eliminate the need for extra work and sweat if an A-plus presentation is sought. Few are willing to give that extra effort. It must pay dividends, though. Those few who do make A-plus presentations make them almost *every* time.

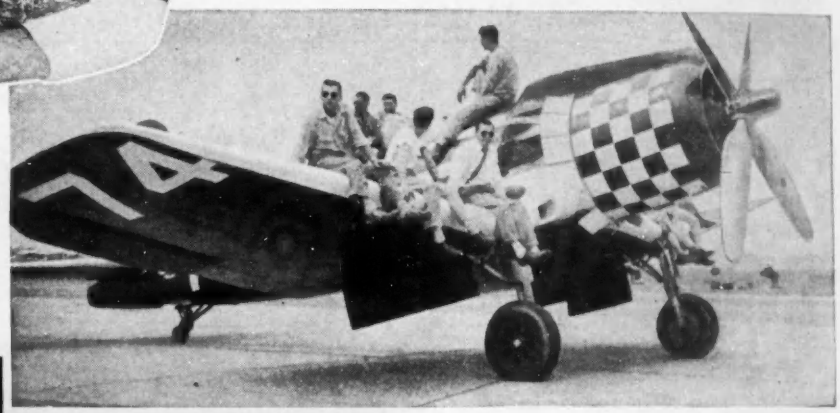
Cook Cleland, World War II Navy Ace, and the Thompson Trophy which he won in the 13th Thompson Trophy Race for piston engine planes.

1947 Thompson Trophy WINNERS

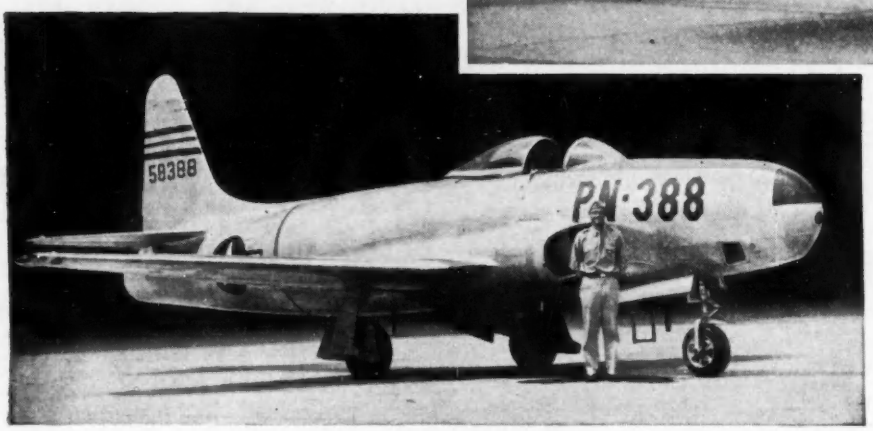
★

NATIONAL AIR RACES
CLEVELAND, OHIO
SEPTEMBER 1ST

The checkered Flag—signal of victory and a new world speed record for closed-course flying in the 1947 Thompson Trophy Race.



Cleland's "Corsair", a stripped-down Navy fighter, set a new world's closed-course speed record for piston engine planes. The 3500 h.p. 28-cylinder Pratt & Whitney "Wasp Major" engine whipped the plane around the 15-mile course twenty times at an average speed of 396.13 m.p.h. Cleland's share of the $42,000.00 prize purse was $19,500.00. Photo shows ground crew.



This Army Air Force P-80 fighter was winner of the Thompson Trophy Race for jet-powered planes. Piloted by Lieut. Com. Robert L. Petit, it averaged 500.70 m.p.h. on its eight laps of a 22.5-mile course. It was equipped with an Allison J-33 turbo-jet engine. Since the war the Thompson Trophy Race has been flown in two divisions, one for piston engine and the other for jet-powered planes. Duplicate Thompson Trophies went to both winners.

SINCE 1930, EACH THOMPSON TROPHY RACE, demanding the utmost "pylon polishing" skill over a closed course, has provided aviation's most gruelling test of speed combined with maneuverability. Beyond the thrills and chills of this spectacular climaxing event of the world's greatest air show is a serious purpose—to encourage the development of faster, safer planes that will hold America's commercial and military leadership in the air.

Thompson Products, Inc.

CLEVELAND • DETROIT • LOS ANGELES • ST. CATHARINES, CANADA

Precision Parts for Automobiles and Airplanes; Manufacturers of the famous Thompson Sodium-Cooled Aircraft and Automotive Valves; Builders of Vanes, Blades and Assemblies for Jet Propulsion Engines.

SAE JOURNAL

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.

C. E. Frudden
President

John A. C. Warner
Secretary and Gen. Manager

B. B. Bachman
Treasurer

Norman G. Shidle
Executive Editor

Leslie Peat
Managing Editor

John C. Hollis
Business Manager

SAE JOURNAL

PUBLICATION OFFICE
56th & Chestnut Sts.
Philadelphia 39, Pa.

EDITORIAL OFFICE
29 West 39th St.
New York 18, N. Y.
Tel.: Longacre 5-7174

ADVERTISING OFFICES
E. L. Carroll
Eastern Adv. Mgr.
29 West 39th St.
New York 18, N. Y.

A. J. Underwood
Western Adv. Mgr.
3-210 General Motors Bldg.
Detroit 2, Mich.
Tel.: Trinity 2-0606

SAE DETROIT BRANCH
808 New Center Building
Tel.: Madison 7495
R. C. Sackett, Staff Rep.

SAE WEST COAST BRANCH
Petroleum Bldg.
714 West Olympic Blvd.
Los Angeles 15, Calif.
Tel.: Prospect 6559
E. W. Rentz, Jr., West Coast Mgr.

The Society is not responsible for statements or opinions advanced in papers or discussions at its meetings or in articles in the Journal.

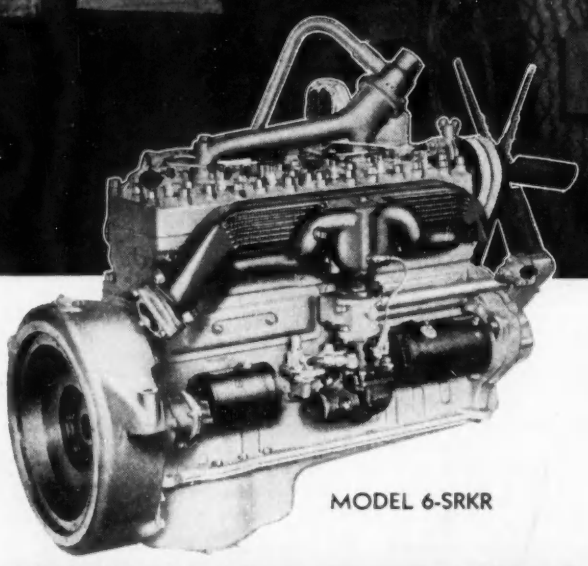
Copyright 1947, Society of Automotive Engineers, Inc.

if you want your

SAE Quarterly Transactions

BOUND

- Send them with your order to Spink & Gaborc, Inc., 26 East 13th St., New York 3, N. Y. They will be bound in stiff buckram cloth-board and mailed back to you with a bill for $3.25. (Color of binding will be maroon, similar to that previously used on annual SAE Transactions.)
- The Publication Committee authorized this arrangement with Spink & Gaborc, Inc., after checking prices and services in principal cities throughout the country.
- Orders must be received before March 1, 1948, to ensure the $3.25 price.



MODEL 6-SRKR

100% more FWD TRUCKS *powered with* WAUKESHA ENGINES

They're out to double production at FWD. And here they are . . . coming right off the assembly line . . . more and more of those Waukesha Engine powered Four Wheel Drive Trucks! There's a lot of heavy hauling in *their* future . . .

Look at this Model 6-SRKR Waukesha Engine and you'll see why. Six cylinders, 4⅝ in. bore x 5⅛ in. stroke, 517 cu. in. displacement—125 hp. at 2250 r.p.m. operating on gasoline. And all of it *real* work-horsepower.

It has that Waukesha precision *balanced* crankshaft . . . of drop-forged steel, heat treated, running in 7 removable precision bearings. That Waukesha deep *girder* crankcase—separate cast-en-bloc *truncated* cylinders—heavy-duty *aluminum* pistons—matched connecting rods. That Waukesha *Blue-flame* manifold, up draft carburetors—*controlled* combustion chamber. Ruggedness with rigidity! More power. More smoothness. Up-and-away acceleration. Higher fuel economy. Lower upkeep. For all details send for *Bulletin* 1124. Consult Waukesha engineers on all your engine needs.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. • NEW YORK, TULSA, LOS ANGELES

WHAT'S IN

THIS ISSUE

OCTOBER

AIR TRANSPORT

Airlines to Smooth Passenger Handling.. 60
Rodney W. King

AIRCRAFT

Automatic Props Improve Light Plane Performance 40
John D. Waugh

BODY

Automotive Trim Materials..... 27
V. J. Fisher

ENGINEERING MANAGEMENT

What a Young Engineer Should Know.. 28
Edmund T. Price

FUELS & LUBRICANTS

Synthetic Engine Lubes Found Economical 24
D. K. Wilson

Modern Oils Impede Engine Wear & Tear 59
C. E. Tilston

POWERPLANTS, DIESEL

Cylinder Wear in Diesels – What Causes It, How It Can Be Measured..... 31
B. M. Berry, A. J. Blackwood, Dr. L. A. Blanc, Karl H. Effman and Norman C. Penfold

Light Weight, Small Size Claimed for 2-Cycle Diesel Barrel Engine..... 49
T. L. Sherman

POWERPLANTS, VEHICLE

Material-Design Fusion Speeds Valve Progress 21
A. T. Colwell

Survey Finds: "Chrome Plating Well Suited to Piston Rings"..... 33
H. O. Mathews

SUSPENSIONS

Ride Comfort Elusive Car Design Criterion 61
Robert Schilling

TRANSPORTATION & MAINTENANCE

Chassis Dynamometer Impels Fleet Operating Economies 36
Errol J. Gay and Henry T. Mueller

Fleet Operation Is Important Business... 54
Frederick J. Horner

Two-Way Radio Grows Into High Frequencies 58
C. F. Meyer

Ties Life of Parts to Painting Method.. 60
Roy B. Davis

European Transport Is Slowly Recovering 62
H. H. Kelly

Modern Maintenance Backs L.A. Bus Fleet 62
Cone T. Bass

TRUCK & BUS

Makes Vehicles Safer by Speeding Air Brake Action 44
Julius Gaussoin

Cost of Bus Is Smallest Expense..... 46
R. G. Hilligoss

Aluminum Truck Bodies Trim Operational Costs 58
F. O. Lewis

Stainless Steel Units Boost Fleet Revenue 60
V. M. Drew

States Raise Limits on Truck Length, Load 61
E. O. Sawyer, Jr.

Postwar Fire Engines Meet Fireman's Needs 62
A. G. Sheppard

SAE National West Coast Transportation & Maintenance Meeting Reported 17

Technical Committee Progress..... 63

About SAE Members..... 66

News of Society..... 72

SAE National Fuels & Lubricants Meeting Program 73

SAE Coming Events..... 74

News of Sections..... 75

Student Branch News..... 84

New Members Qualified..... 88

Applications Received 89

Seeking a new Selling Feature?

...put it up to Bendix Products

PARTNERS IN AUTOMOTIVE PROGRESS FOR OVER 30 YEARS

If you have a new selling feature, or an idea for one that you want developed to meet specific requirements, it pays to put it in experienced hands. That's why the list of Bendix* Products' clients reads like a bluebook of the automotive industry. The industry has learned that when it comes to turning an idea into a soundly engineered product, suitable for volume production, and held to a price, Bendix Products can usually provide the answers. Over thirty years of partnership with the industry proves it pays to put it up to Bendix.

BENDIX PRODUCTS DIVISION of
SOUTH BEND 20, IND.

Bendix Aviation Corporation

HYDROVAC* POWER BRAKING
CENTERMOUNT PARKING BRAKE
HYDRAULIC REMOTE CONTROLS
UNIVERSAL JOINTS

Bendix PRODUCTS DIVISION

TRAILER VACUUM POWER BRAKES
B.K.* VACUUM POWER RELAY VALVES
HYDRAULIC POWER STEERING
WHEEL BRAKES

*REG. U. S. PAT. OFF.

WORLD'S LARGEST INDEPENDENT AUTOMOTIVE PARTS PLANT

VEHICLE OPERATORS

Face Challenge of National Economic Expansion, Safety, and Lower Costs

A LEADING banker keynoted the SAE National West Coast Transportation & Maintenance Meeting Aug. 21 to 22 in the Hotel Biltmore in Los Angeles, when he said:

"Industry and agriculture are stepping up their tempo so fast that even the quick-moving highway transport business is seeming to lag."

The technical program of the meeting had been geared to face squarely just that economic challenge. Practical ideas were expounded which could go far to enable highway transport to solve the new problems posed by the industrial and agricultural fields it serves. President C. E. Frudden in his banquet speech at the meeting's end assured the audience that in the cooperative technical work of the Society, and in pooling information at meetings such as this, lies the solution to the problems ahead, and Past-President A. T. Colwell, also at the banquet, urged wide acceptance of scientific maintenance to keep the industry a profitable one.

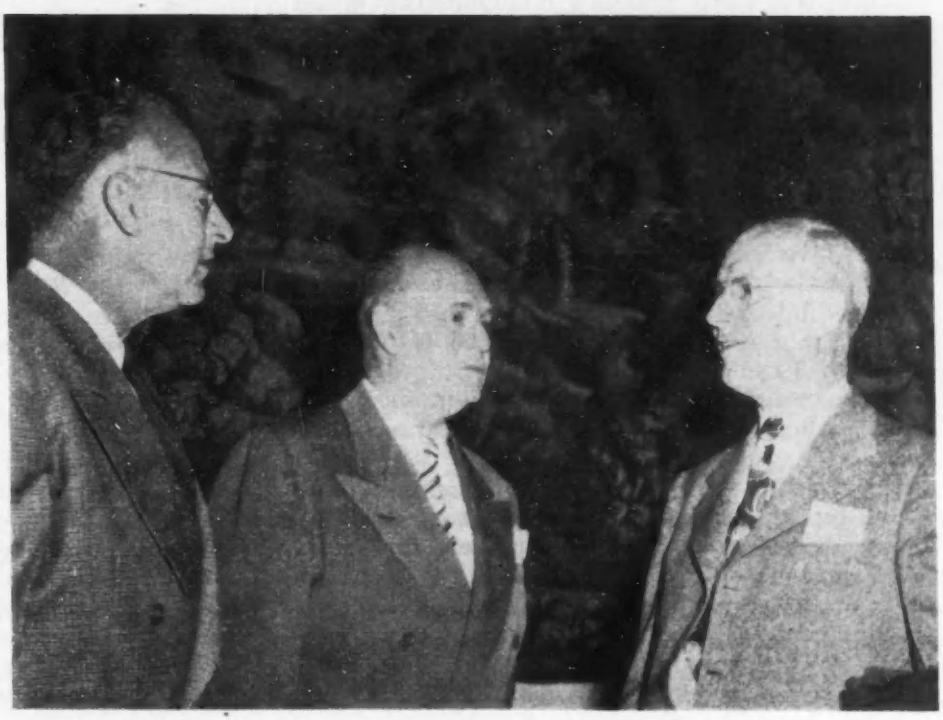
1. Specific ways to better brakes, scientific driver selection and training, stimulated high - school driving courses, and improved trailer hookups were detailed as means of preventing accidents on a national road system that can't grow fast enough to keep up with increasing vehicle registrations.

2. Methods were outlined for curbing increased labor and materials costs by designing and treating parts to wear longer, a report of a plastic brake lining bond to reduce frequency of relining, suggested steps in fitting trucks and trailers to jobs they are to do, use of more suitable garage equipment, inspection devices, and precision tools, a thorough system of preventive maintenance to reduce costly repairs, and sound timing for retiring old vehicles.

3. Public relations and legislative approaches were specified to keep the highway transport business free to meet the rapidly changing needs of the economic environment in which it works.

Of the four roads to improved safety, that of brake system betterment got primary attention.

Col. L. L. Beardslee, general chairman of the SAE West Coast T&M Meeting, left, with Gen. Joseph O. Donovan, center, who welcomed the meeting in behalf of Mayor Fletcher Bowron of Los Angeles, and SAE President C. E. Frudden, who made the acknowledgment for the Society.



Several men whose work made the meeting an outstanding success are shown at the speakers table of the luncheon sponsored by the Fruehauf Trailer Co. Starting from left to right are J. W. Sinclair, C. L. Fernau, F. C. Patton, W. J. Pickhardt, Harry McLelland, General Chairman Col. L. L. Beardslee, speaking. Beyond Col. Beardslee are L. J. Grunder, E. G. McMannamy, and Frank Radovich

It appeared agreed that redesign of the air brake system can eliminate dangerous lag in actuation, and elimination of front wheel brakes in hilly terrain was urged.

Psychology has stepped in to make a better choice of prospective drivers and has shown how to do a better job of training with gratifying results.

There was ample evidence to indicate that sound engineering is needed in fifth wheel design in the interest of safety.

To Reduce Maintenance

Reduction of costly mechanical wear was attacked from the standpoints of lubrication, chromium platings, and shot peening to relieve unwanted stresses.

A plastic bond of brake lining and shoe nearly doubles lining life, improves bearing strength eight fold, and ups shear strength 600% as compared with the conventional riveting process. The savings in this maintenance operation was good news to fleet operators beset by mounting labor costs.

A new avenue to economical operation was opened up by two speakers who outlined methods of proper selection of trucks and trailers for specified transport jobs, and delineated the steps to be taken to assure a proper fit of the vehicle to the highway grades, character and weights of loads, and other salient factors.

Excessive maintenance costs are bred by unsuitable shop equipment, inconclusive inspection devices and lack of precision tools, one engineer told the meeting. He warned that common sense must be used in sifting claims for alleged labor saving devices. Dynamometers, torque wrenches, precision machine tools, and improved shop layout mean more work done per man-hour, a paramount consideration of all fleet operators these days.

Much of the guessing can be taken out of timing the retirement of vehicles if accurate maintenance records are kept, and sound judgement is used. Engineers agreed that guessing can be costly.

Good Public Relations Urged

Freedom from excessive regulations in order to meet the challenge of a changing economy can be attained in a large measure through improving the motorist's impressions of the truck and bus driver through courtesy on the road, one speaker insisted.

Another denied that fleet operators were too prone to exert pressure on legislators for changes in regulations to the public's detriment. Improved publications, in general, were suggested to improve the lot of the nation's fleet operators.

Brake Design Held Inadequate

Cooperative tests of heavy duty air brake equipment were reported stemming from a series of accidents on the tortuous and steep highways along the Pacific Coast.

The tests involved modification of air brake systems to find, under actual operating conditions and simulated conditions, the weaknesses of standard equipment. Lag of the actuating members was suspected, and the test results reported proved the point.

Larger tubing, T's, L's, and other airflow restrictions were removed to permit faster flow of air. Industrial air couplings were substituted for the conventional automotive types, and quick re-

Seated at the speakers table of the banquet which closed the two-day meeting were, left to right: SAE Past-President A. T. Colwell, banquet speaker; R. Wayne Goodale, toastmaster; and President Frudden, who outlined significant developments in SAE technical work.

Speaking is R. W. Cochran, chairman of the Southern California Section and of the banquet; General Chairman Col. L. L. Beardslee; and E. W. Rentz, Jr., manager, SAE West Coast Branch office

lease valves were eliminated. Long-throw brake pedals and treadles were shortened to reduce driver reaction lag. Rubber jumper hoses replaced metal core units. Brake chamber sizes were reduced and brake adjuster levers were shortened to prevent brake locking. Rate of flow of relay emergency valves was increased. Cab valves in the driver's cab were eliminated, and the front wheel brakes were disconnected.

Compared with the same vehicles prior to these modifications, stopping distances averaged 41 ft as against an average of 75 ft.

Psychology Enlisted as Safety Aid

Extensive work done by psychologists in fitting drivers to jobs was reported as back of a plan which has resulted in reduced incidence of accidents.

Because highway accidents usually involve a number of contributory causes, it was shown that a training program for new drivers is essential, as is a careful record of each driver's accidents. The record of 250 trained drivers and the same number of untrained drivers was cited where the former had only half as many accidents as the latter.

Considerable driver training is being done at the high-school level, where it is badly needed, since published surveys show youths of 16 to have a fatality record nine times that of middle-aged drivers.

While demands for more highway transportation are increasing and annual registration figures continue to climb, new local, state, and federal highway programs will be insufficient to carry the excessive load safely unless careful driver selection and training become the rule rather than the exception.

Engineering the Fifth Wheel

Several speakers and discussers believed that fifth wheel designs of today are inadequate. Positioning of fifth wheels was widely criticized and several operators have set up standard modifications to prevent jack-knifing. In addition, lubrication is frequently washed out.

Cost Reduction

Due to increasing labor and materials costs the Program Committee put considerable emphasis on the broad question of vehicle maintenance.

Compounded oils, the Mechanical Symposium brought out, show better oil condition after 5000 miles than do identical base oils, without the compounds, after 1000 miles.

Design considerations of mechanical parts were detailed and it was shown that progress is being made due to a better understanding of lubrication on the part of designers.

Chrome Plating Reviewed

Vehicle users were urged to use chrome plated rings in original equipment as another measure of meeting maintenance cost problems. Reclamation of used parts by such plating is not economical.

Chrome plated rings and walls were shown not to work well together, but rings so plated are quite satisfactory according to tests. Due to failure of other parts, however, their full value may not be realized. Several operators reported that up to 20% in oil economy resulted from chromium plated rings.

An operator of heavy-duty equipment reported that operation showed from three to five times the life of ring sets when the top ring was chrome

Cooperating with General Chairman Col. L. L. Beardslee were Ellis W. Templin as chairman of the Program Committee and his colleagues Wallace Linville, E. G. McMannamy and James V. Sinclair, the Section's new vice-chairman for T&M.

Fred C. Patton's Arrangements Committee consisted of C. L. Fernau and Frank Radovich, the Section's Secretary. L. J. Grunder headed the Reception Committee.

Besides R. W. Cochran, head of the Southern California Section and chairman of the participating Sections and Groups, were Charles A. Winslow, Northern California; D. D. Thomasson, Northwest; Howard H. Morse, Oregon; Frank W. Fink, San Diego; Hugh P. Kanehl, Spokane-Intermountain; E. R. Donner, Salt Lake, and Phil J. Schrodt, British Columbia. Several of these men took an active part in preparing the program and conducting the sessions.

■

Based on discussions and 10 papers presented at the five technical sessions of the SAE National West Coast T&M Meeting, Aug. 21 and 22, in Los Angeles. Technical session chairmen were Earl B. Richardson, E. R. Donner, Murray Aitken, Dr. Vernon D. Keeler, and Hugh P. Kanehl . . . "Brake Operation Troubles," by Julius Gaussoin, Silver Eagle Transportation Co.; "Plastic Bonding of Brake Lining," by Ralph T. Hickcox, Goodyear Tire & Rubber Co.; Symposium on Mechanical Wear – How to Reduce It: "Lubrication," by W. M. Sopher, Union Oil Co. of Calif.; "Chrome Plating," by Col. Harry O. Mathews, Standard Brands, Inc.; and "Shot Peening," by Fred K. Landecker, Metal Improving Co.

"Fleet Operation is Important Business," by Col. Frederick C. Horner, General Motors Corp. Symposium on Transportation Management Problems: "Regulations," by Col. E. O. Sawyer, Jr., Western Motor Transport, and "Driver Selection and Training," by Dr. V. F. Larsen, V. F. Larsen Co. Symposium on Selection and Application of Equipment: "Trucks," by J. Nevin Bauman, White Motor Co., and "Trailers," by V. M. Drew, Fruehauf Trailer Co.

plated. The lower rings were apparently protected by the top members, he said.

The meeting was brought up to date on the developments of shot peening, a great deal of work on which has been done by technical committees of the Society, some under the chairmanship of J. O. Almen, Research Laboratories Division, General Motors Corp.

Reported were specific examples of longevity, and manufacturers were urged to use the process more in original equipment. Success in processing parts such as springs, axle shafts, and crankshafts for a number of truck and bus fleets was cited as well.

A gear expert pointed out that shot peening root fillets of involute gears has a two-fold benefit: the surface of the fillet is prestressed in compression, partially balancing the applied load, and the process peens over and smooths hob and cutter marks in the root fillet.

Main drive spiral bevel pinions and axle shafts for an 18 cu yd self-propelled scraper, subject to high loading, are shot peened with a substantial increase in life, he reported. A shot peened gear stressed to 80,000 psi would stand up under some 30,000,000 cycles of fatigue life, whereas one not so treated would have a predicted life of only 200,000 cycles.

Other cost-reduction ideas were developed in a description of a plastic bond which, on the average, nearly doubles brake lining life. With the bond, which has six times the shear strength of a riveted assembly, the operator gets the entire use of the brake lining's original thickness instead of discarding about half the lining when a riveting job is done.

The lining and shoe are cleaned and a liquid thermosetting plastic is brushed on both surfaces. Allowed to dry half an hour, the two surfaces are pressed together and cured for 30 min at 375 F in a thermostatically controlled oven. Then, cleaned of excess resin, the lined shoe is installed.

In a Detroit taxicab fleet test, it was reported, riveted lining had been replaced every 12,000 miles. Plastic bonded linings ran from 22,000 to 25,000 miles, depending upon the severity of the service.

Severe stop-and-start tests have been made with a fleet of cars stopping from speeds of 50 and 70 mph, at a rate of deceleration of 18 ft per sec per sec, barely above the skid point of the tires.

After 2000 stops, the brakes were examined and no deterioration of the bond was detected. No scoring of drums was found.

Proper Vehicle Choice

A fruitful method for reducing costs is in proper selection of trucks and trailers for the jobs they are bought to perform, it was shown in the symposium on Selection and Application of Equipment. A recommended eight-step plan set up the factors and showed how to determine the answers for a particular transportation job required of the truck to be purchased.

"Unless proper consideration is given to the use of motor trucks, the highway transport industry will always be penalized by excessive costs, and never can get the full potential of the investment," he concluded.

Safety and economy performance ability of trucks and trailers should be rated at 45 mph up a 6% grade, one engineer brought out. To do this, he said, an extra 500 or 600 hp should be available intermittently.

On the subject of trailers, permissible sizes and weights, operational or commodity requirements, and general operational economies were cited as the proper basis for selection. One discusser pointed out that reduction should be made in the number of parts in tandem axle assemblies, favored

concluded on page 53

MATERIAL-DESIGN FUSION SPEEDS VALVE PROGRESS

Counters Operational Severity Imposed by Heavy-Duty Engines

EXCERPTS FROM A PAPER* BY

A. T. COLWELL

Vice-President, Thompson Products, Inc.

(This paper will be published in full in SAE Quarterly Transactions)

THERE is some combination of exhaust valve and seat-insert design that will meet any requirement known in heavy-duty operation today. Numerous mechanical and design factors apart from the valve itself can be valuable. A hardened seat insert of good physical properties will be universally used in the future. The present practice is to add a hard facing material to a solid valve for the valve face. The next step – now getting under way – will be sodium cooled valves. Positive rotating valves will be widely used in the next few years. Some progress in heat-resisting alloys for turbine engines may be applied to valves if cost will allow.

There is no perfect valve steel – no perfect alloy for any purpose, for that matter. Chromium is the key to oxidation and corrosion resistance in a valve steel. Oxidation and corrosion resistance are achieved by a tightly-adherent refractory oxide film formed on the steel, which prevents further attack. An analogy is the use of lead in handling dilute sulphuric acid; the lead becomes protected by a thin acid-proof layer of lead sulphate.

Because there is no perfect valve steel, the metallurgist uses combinations of materials to get a satisfactory valve.

Exhaust valve steels fall into three categories, as follows:

1. The Ferritic Group – The ferritic group is hardenable by heat-treatment, has a low coefficient of expansion, is comparatively easy to handle at the mill and in manufacture, and has comparatively good heat conductivity. Hot hardness is relatively low, and resistance to fatigue, corrosion, and stretch is, in general, lower than in the other groups.

2. The Austenitic Group – This group has excellent hot strength, generally good corrosion and oxidation resistance, with hot hardness higher than the ferritics, and has no critical temperature. It is difficult to forge and machine, can only be hardened by mechanical work, and has a high coefficient of expansion with relatively poor thermal conductivity.

3. Sigma Precipitate Group – This group has the outstanding characteristics of high hot hardness, good corrosion and oxidation resistance, good stretch resistance, and can be hardened with a long heat cycle. Thermal expansion and conductivity fall between those of the first two groups. It is very difficult to handle at the mill and factory. It contracts upon hardening, and analysis must be closely held to get the desired properties. The hard seat, stem, and tip – coupled with other properties – make it the finest of valve steels.

Assessing Valve Steels

New and better methods of evaluating valve steels have been devised, but field results may agree or widely disagree with the laboratory. For instance, the laboratory corrosion test on TPA steel is not impressive; but in engine operation it has given good results for a number of years. The

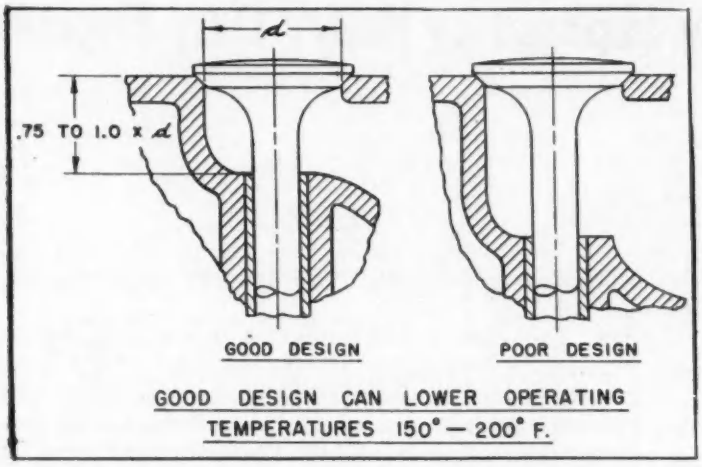
*Paper "Corrosion Resistant Metals for Valves and Seats on Heavy-Duty Engines," was presented at SAE Summer Meeting, French Lick, June 2, 1947.

engine in service gives the answer on valves. Properties formerly considered detrimental in a valve steel have proven satisfactory in use. And some alloy combinations have shown unexpected properties.

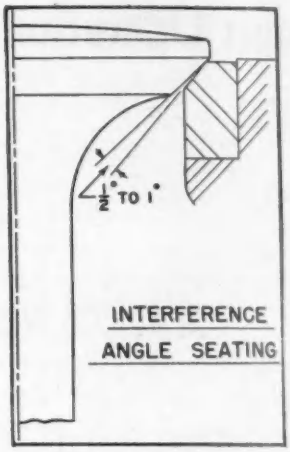
The engineer has lessened the burden on the metallurgist in many ways . . . sodium-cooling, improved block and port design, efficient retainer locks, and the latest help – the positive valve rotator. The constant clearance regulator, improved valve motion through cam design, and good seat-insert design have helped.

Working against the metallurgist, and beyond his control, have been the continual stepping up

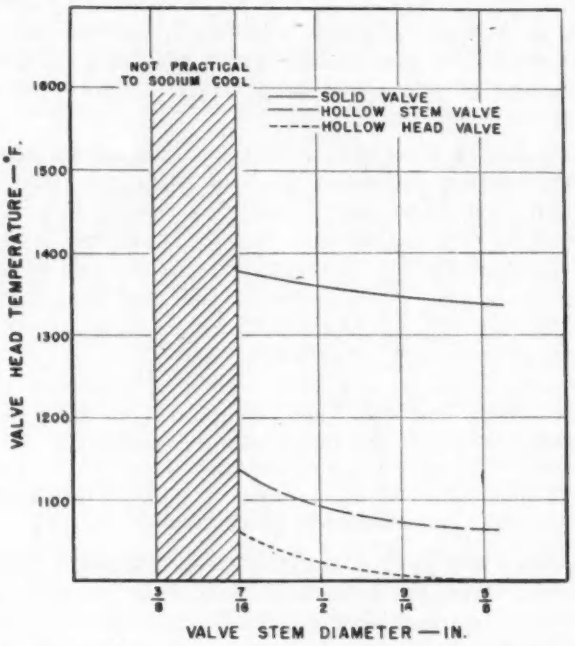
How the Engineer Can Help the Metallurgist



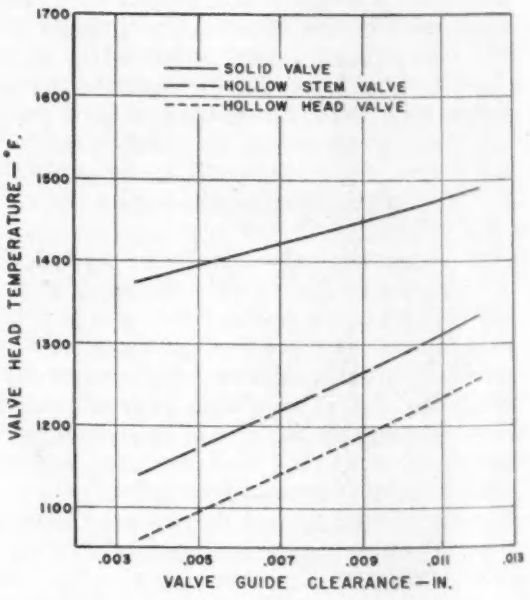
1. Good Port Design This shows good and bad port design. The sweeping port with a high boss tends to improve exhaust valve operation.



2. Proper Seating Particularly helpful in the case of guttered valve faces caused by corrosion starting at the outer edge, this design – with an interference angle on the valve face – assures seating at the outer edge.



3. Right Stem Size This chart indicates that the larger the stem, the cooler the head – provided the guide can dissipate the additional heat taken from the head.



4. Guide Clearance Larger clearance makes for a hotter valve head, this chart discloses. Good lubrication aids cooling appreciably.

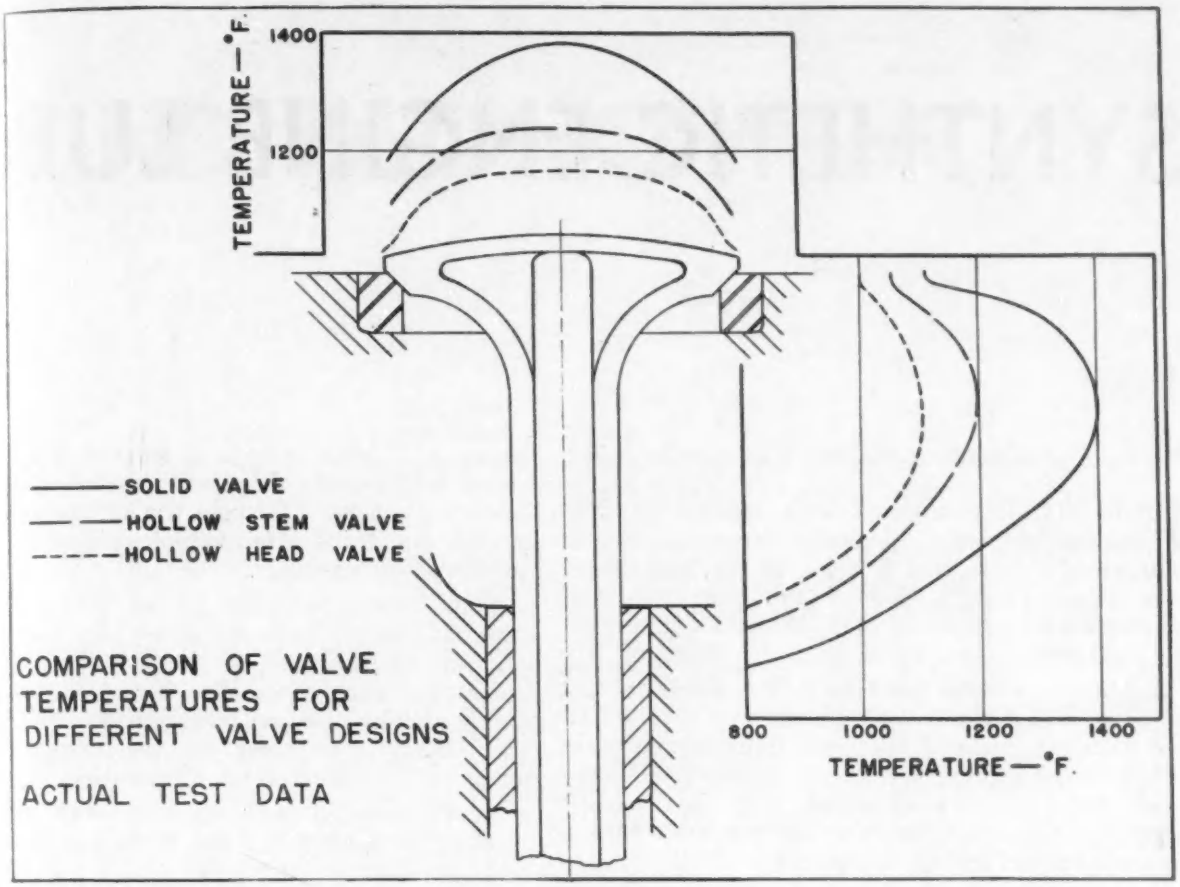


Fig. 1 – Comparison of valve temperatures for different valve designs

of power, high road speed of overloaded vehicles, and the tendency of some fuels and oils to deposit varnish, causing valve sticking. However, heavy-duty valves today can give very satisfactory performance at reasonable cost.

Extensive and lengthy tests have been run to evaluate valve heat transfer and operating temperatures. The tests closely confirm what we have known empirically. Fig. 1 shows temperatures found with different designs. Lowering valve temperature only a slight amount may take it out of the critical range for failure.

Valve Rotation

The positive valve rotator is the greatest advance in valve technique since sodium-cooling and hard facing, and adds appreciably to valve life. Both dynamometer and field tests have been amazing. The valve rotates slowly in the guide without interfering with normal operation, continually giving a light wiping action to valve and block.

Stem deposits are prevented from forming at the top of the guide, thus greatly relieving valve sticking. Seat blowby and sticking account for about 90% of valve troubles. If leakage does occur at one point, the continual rotation minimizes overheating, guttering, and burning at that point.

Seat Inserts Save Valves

Hard valve seat inserts have become general practice, and are a necessity in many engines, desirable in all engines. They increase the time between valve grinding, prevent block pounding and pick-up ("warts"), lessen distortion, and provide better seating by maintaining hot hardness. The desirable properties of a seat insert are hot hardness, good physical properties to resist distortion, and oxidation and corrosion resistance.

In some cases seat inserts are faced with Stellite No. 6 for improved corrosion resistance. They are also cast of Stellite No. 6 for some installations. Various combinations are satisfactory – Stellite-faced valve on Stellite-faced seat, Stellite-faced valve on hardened seat insert, or unfaced valve on hardened insert.

Seat-insert failures are comparatively rare as the operating temperature is quite low. Corrosion on the seating surface is a factor, however. Too great a press fit can cause a permanent set in the block, leading to loose inserts.

SYNTHETIC ENGINE LUBES

(This paper will be published in full in SAE Quarterly Transactions)

DOUBLED oil change periods, cleaner engines, gasoline economy, generally decreased overall maintenance costs, and better cold starting ability were found in nearly three years of field testing of synthetic lubricants,[1] as compared with detergent oils used in the same vehicles.

In these extended tests on prime movers of 23 vehicles in heavy-duty service, it was also found that a single grade of synthetic lubricant successfully covered a greater range of ambient temperatures than could be expected with Heavy-Duty petroleum oils. Temperatures encountered during the tests ranged from —25 to 99 F.

Reduced carbon deposits were found, particularly on valve stems, and this carbon was softer than that deposited with other types of lubricant. Rings operated slightly more freely.

During the test period, the vehicles totaled more than 600,000 miles, and several equipped with power-take-off for compressors and other equipment ran up thousands of engine hours in addition. One, a 1941 cab-over-engine compressor truck with a 237 cu in. L-head engine, driving a 105 cu in. single stage compressor through a split propeller shaft power-take-off, was under test with synthetic lubricants from August, 1944, to April, 1946. During this period it traveled 4456 vehicle miles, but also operated 20,123 engine miles, a ratio of about 1 to 4.5.

The seven power-take-off compressor trucks averaged about one to three-and-a-half vehicle miles to engine miles, rendering the normal crankcase ventilation system almost inoperative most of the time during the tests. They totaled 189,862 engine miles during this period.

Tabulated results showed increased engine cleanliness, and drain periods at least doubled, as compared with results obtained from the detergent oils previously used. Despite the extended oil drain period, six of the seven vehicles showed somewhat improved oil economy.

Since September, 1944, about 3500 hr of operation have been run on a track-laying tractor working on the ash pile of the company's principal steam generating station. Prior to the test, it had been lubricated with regular SAE 30 in winter and SAE 50 in summer, and oil changes had been made at from 30 to 40 hr of operation.

Never garaged, and working day and night, starting had always been a serious problem. A rope attached to the hand crank was pulled by several men to turn the engine over, or it was towed in gear with a steam locomotive-crane. Lighter grade petroleum oil helped, but then oil pressures dropped during normal operating temperatures. Under all weather conditions the operator can now spin it over, its drain period has been nearly trebled to 100-hr periods, the engine is clean, and no sludge has been observed. Oil consumption has been normal.

In accumulating a total of 127,540 engine miles on test with No. 300 synthetic engine lubricant, a group of four earth-boring trucks have had oil changes ranging up to 9200-mile intervals – and this is being further extended to 12,000 miles with 3000-mile samplings and filter cartridge changes.

Although the ratio of vehicle to engine miles ranges from two to three to one, and averages 2½:1, engine cleanliness has been satisfactory and oil economy has been equal to pre-test experience with SAE 30 in summer and 20 in winter.

Easier Starting

During cold weather, earth borer cases chilled and operators complained of the stiffness of the operating levers. When No. 200 synthetic lubricant was substituted for the SAE 10 petroleum oil previously used, these complaints have stopped.

With synthetic lubricants, three winch-equipped line trucks have had oil changes ranging up to 8000 miles without exceeding 0.5% ash content.

---

[1] Prestone Motor Oil No. 300, a polyalkylene glycol derivative. See "New Synthetic Lubricants" by J. C. Kratzer, Linde Air Products Co.; D. H. Green, National Carbon Co., Inc., and D. B. Williams, Carbide & Carbon Chemicals Corp., Units of Union Carbide & Carbon Corp., presented at the SAE 1946 Annual Meeting, Jan. 7, P. 228, SAE Transactions, 1946, Vol. 54.

* Paper "Fleet Tests of Synthetic Lubricants" presented April 17 at the SAE National Transportation Meeting, Chicago.

FOUND ECONOMICAL

BASED ON PAPER* BY **D. K. WILSON**
Superintendent of Automotive Equipment,
New York Power & Light Corp.

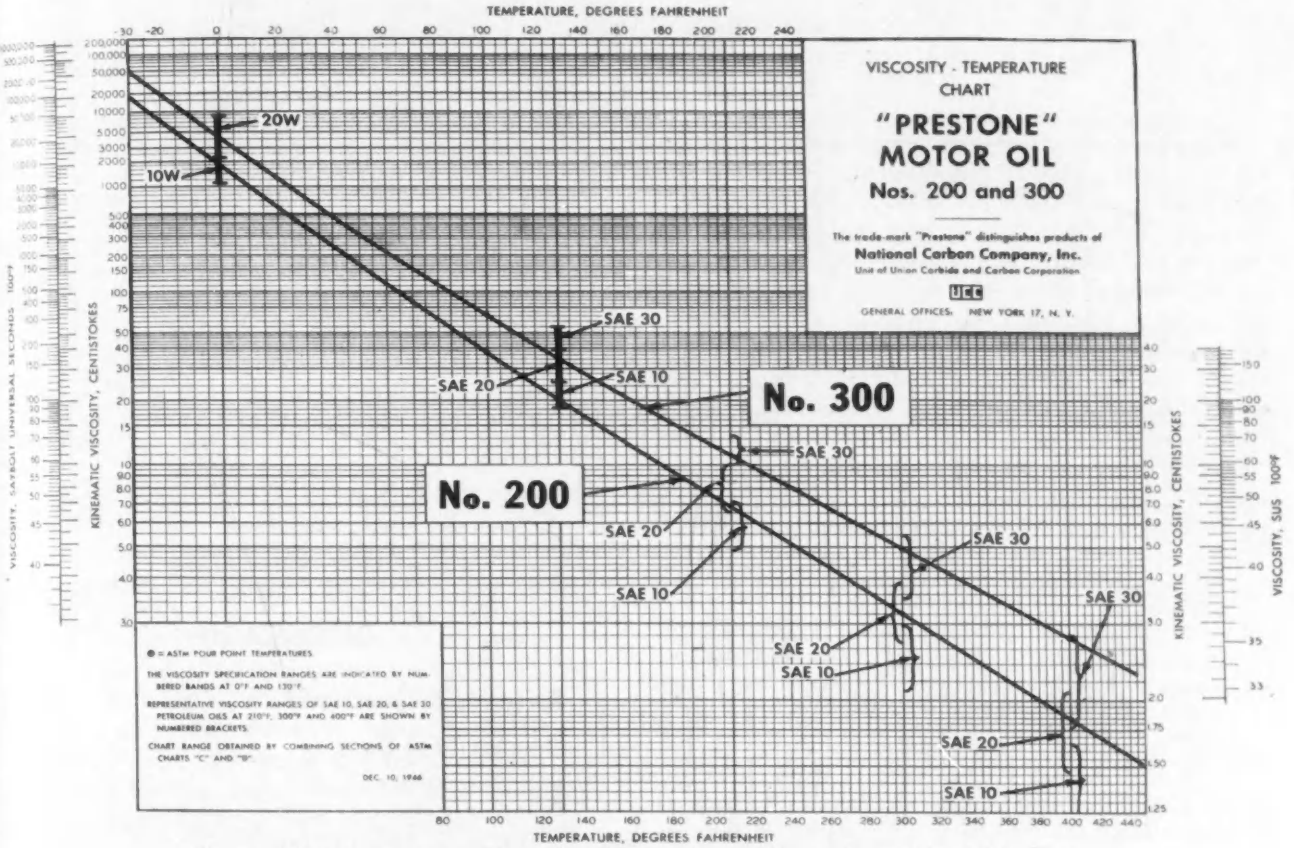

TEMPERATURE, DEGREES FAHRENHEIT
VISCOSITY - TEMPERATURE CHART
"PRESTONE" MOTOR OIL
Nos. 200 and 300
The trade-mark "Prestone" distinguishes products of
National Carbon Company, Inc.
Unit of Union Carbide and Carbon Corporation
UCC
GENERAL OFFICES: NEW YORK 17, N. Y.
20W
10W
SAE 30
SAE 20
SAE 10
No. 300
No. 200
KINEMATIC VISCOSITY, CENTISTOKES
VISCOSITY, SUS 100°F
* = ASTM POUR POINT TEMPERATURES.
THE VISCOSITY SPECIFICATION RANGES ARE INDICATED BY NUMBERED BANDS AT 0°F AND 130°F.
REPRESENTATIVE VISCOSITY RANGES OF SAE 10, SAE 20, & SAE 30 PETROLEUM OILS AT 210°F, 300°F AND 400°F ARE SHOWN BY NUMBERED BRACKETS.
CHART RANGE OBTAINED BY COMBINING SECTIONS OF ASTM CHARTS "C" AND "D".
DEC. 10, 1946

Fig. 1 – Viscosity-temperature chart of synthetic engine oils No. 200 and 300. ASTM pour point temperatures. The viscosity specification ranges are indicated by numbered bands at 0 and 130 F. Representative viscosity ranges of SAE 10, 20, and 30 petroleum oils at 210, 300, and 400 F are shown by numbered brackets. Chart range obtained by combining sections of ASTM charts "C" and "D"

the tentative limit, as compared to the 3000-mile period when using detergent oils. Used oil analyses included viscosity, ash content, and acidity. However, the most significant value is ash, apparently. Cold weather starting improved.

To judge the action of synthetic lubricant in high-mileage, two units were selected. One was a one ton "metropolitan" delivery vehicle powered by a 213 cu in. L-head engine. While units of this type are generally used in stop-start service, the shape and size of this vehicle are particularly well adapted to the needs of long distance service. With modifications, these are used on nightly runs throughout the territory, carrying needed small materials.

The two trucks selected for test in August, 1944, were 1941 models, previously lubricated with Heavy-Duty detergent SAE 30 oil. The first vehicle started on test with a mileage of 113,000 and ran 35,000 miles during the first year of test, at which time it was "shopped" for engine overhaul.

Engine cleanliness was highly satisfactory. Slight, but very soft, carbon formation was noted on the pistons. Some reports of valve sticking had been received prior to the use of synthetic oil, but

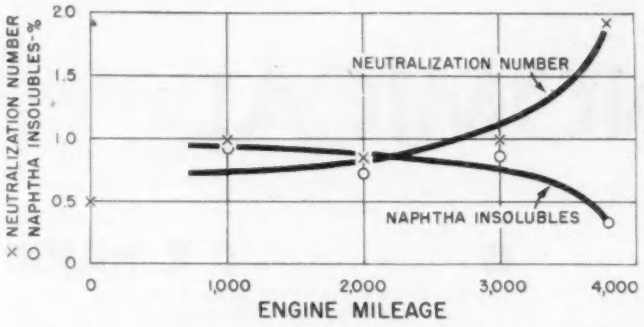


Fig. 2 – Heavy-Duty detergent oil. Neutralization number and naphtha insoluble curves, vehicle No. 59

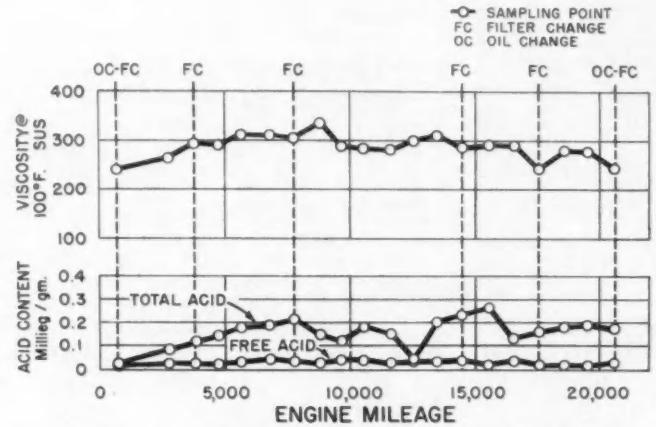


Fig. 3 – LB-300 synthetic engine oil: viscosity and acid curves, vehicle No. 59. Tentative limits: milliequivalents per gram. Total acid 0.3, free acid 0.05

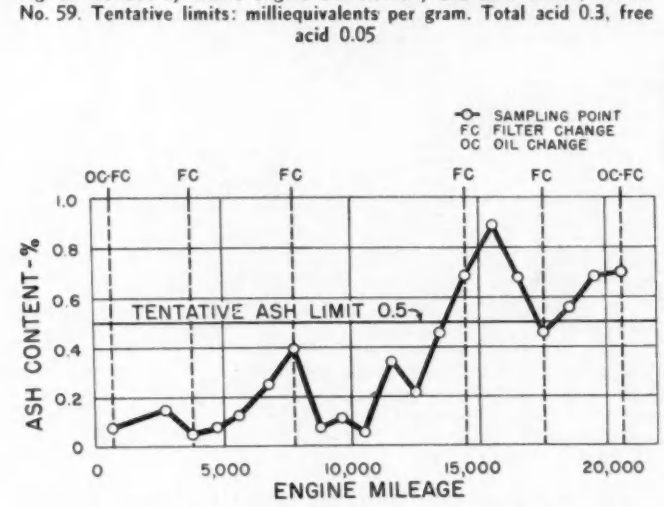


Fig. 4 – Ash curve of LB-300 engine oil, vehicle No. 59

no such reports were received subsequent to its use, and the valves were readily picked out of the guides at the time of overhaul.

Following overhaul, this vehicle was again put on test until June, 1946, when it was replaced by a new vehicle. This truck ran 64,000 miles in 22 months of test, its life mileage being 177,000 at the close of the test. Ash content of used samples did not exceed 0.181% during the entire test period. Lubricant and filter cartridge changes ranged up to 12,000 miles. When using detergent oil, lubricant and filter cartridge changes were made at 6000 mile intervals.

The second vehicle started on test with a mileage of 131,000, and accumulated 55,000 miles in 19 months of test, when it was replaced by a new truck. Oil drain and filter cartridge changes were not too well co-ordinated in this test, with the result that four different ash value determinations, taken just prior to and following a motor overhaul at 43,000 test miles, exceeded the 0.5% limit, the highest value being 1.17%.

Two new vehicles of similar type were placed on test in 1946, and have so far accumulated 32,000 and 16,000 miles, respectively. Ash values of samples taken, to date, have not exceeded 0.15%. An 18,000 mile drain period is indicated on the basis of the present test.

Three light passenger cars have been on synthetic oil test from time to time since 1944. These have been driven by the writer to facilitate personal observation of the use of synthetic lubricant. One car was filled with No. 300 oil, the other two with No. 200. Only 27,000 miles have been accumulated on these vehicles. No conclusions will be drawn from this phase of the test, as it is desired to avoid expressions of personal opinion.

DISCUSSION

Raise V. I. Question

Discuss Test Data

ALTHOUGH tests with other vehicles confirmed and amplified conclusions drawn by the author, Wilbur G. Perriguay and Edgar H. Berg, Standard Oil Co. (N.J.) offered the determination that the synthetic oil of 142 Dean and Davis viscosity index will have a performance V. I. of 128, whereas a mineral oil having a Dean and Davis V. I. of 128 will also have a performance V. I. of 128.

It was not clear to them why the synthetic oil with a viscosity at 300 and 400 F equivalent to an SAE 30, satisfactorily fulfills the high temperature requirements for which the author had previously found an SAE 50 necessary.

Testing both a heavy duty service tractor-trailer and a bread delivery truck which made numerous stops, E. F. Collins, lubrication engineer, GMC Truck and Coach Division, found that LB-300 synthetic oil kept the engines clean.

The 270 cu in. tractor-trailer engine's head was removed at 70,000 miles. At that time, he said, the oil consumption pattern indicated satisfactory

continued on page 57

Automotive TRIM MATERIALS

BASED ON PAPER* BY **V. J. FISHER**

Director, Trim Fabric Standards and Specifications, Fisher Body Division, General Motors Corp.

INTENSIVE research, experimentation, and development programs to improve automobile trim materials are now going on in fabric, chemical, and car plants throughout the country.

For years the main factors used in determining the ideal automobile upholstery fabric have been ability to take hard wear for long life, maximum style and beauty to achieve smart and luxurious trim effects, ease of handling and fabrication, elasticity and softness for comfort, ventilation for dissipation of body and interior heat, and maximum resistance to spotting.

Today, however, research specialists and engineers working on the fabrics of tomorrow have added slideability as a requirement. The ease with which the driver or passengers slides across the seat is an important aspect of new materials.

During the early, small-production years of the industry most cars were open and genuine leather was used. With the advent of the closed car, established carriage cloths were the vogue.

In quest of luxury, trim designers turned to velours which had been used for furniture upholstery, and these found wide acceptance among automobile buyers, and pile fabric or mohair velvet was used for many years in closed cars.

Through the years, wools and woolen fabrics with adulterants, cotton, rayon, and combined fabrics have been tried or considered. As a result, car manufacturers have a wide choice.

As in every field, there have been numerous claims of newly styled and indestructible materials which would be in abundance as soon as needed by the automobile industry. Although every known material has its drawbacks, serious work is being done which will probably give the motorist a luxury in trim materials he has never known.

To date, however, none of the "fibers of the future" tested have the qualities which would receive wide public acceptance in closed cars. But better materials are in prospect.

For a large production line of cars we have discovered from experience that we must be rather conservative in the selection of color. The inside of an automobile must not be objectionable when compared to the color of the outside. It must be comfortable, and should not make a definite or lasting impression upon the customer's mind.

If the automobile handles well and the prospect enjoys his ride he shouldn't be too conscious of the inside color or color combinations. Thus, experience has taught us that the trim should be rather neutral – certainly not loud.

Avoid Excessive Contrast

Even in the trimming, the stylist must be careful not to get too much contrast in texture or in color in the car's interior. The headlinings, windcords, arm rest covers, bindings, and floor coverings are sometimes contrasted for this purpose, even in high production cars.

Deluxe or special trims are available, but at a premium because there is always a loss in production time and other expenses in handling all special or low-volume pieces of material.

A part of the work of a trim choice is a program of accelerated wearing and light fading tests on specialized "torture" equipment. Some of these are: for tensile strength, stretch and recovery, fiber content, color fastness to light in a fadeometer and in the sunlight, its ability to stand water spotting, coefficient of drag, porosity, resistance to staining and how it can be satisfactorily cleaned. Its ability to wear well is determined in an abraser.

Genuine leather or substitutes are tested for color bleeding, resistance to surface cracking, its spew or exudation point, how it ages, fastness to perspiration, and how firmly the coating is anchored to the hide or the fabric.

*Paper "Automotive Trim Materials" was presented at the SAE Summer Meeting, French Lick, Ind., on June 3, 1947.

What a Young Engineer S

MOST men, including engineers, wish to make successes of their lives. Other than an attitude of mind or a prearranged plan of life, there is no formula for individual success. Success or, as I prefer to call it, fulfillment will not yield to a graphical presentation of the complex variables which intrude upon the human mind or which influence conduct.

Some of these variables include the muddy thinking imposed on us by the philosophy of governmental control during the past decade and a half. In this confusion the technically trained man has also suffered – particularly with the sudden end of the war when he finds his talents no longer in acute demand. In business, I know of no men nor group of men who are more puzzled as to their proper place in society than the engineers.

Fundamentally the engineer supplies the idea or conception and then he relies, particularly in a complex modern society, upon the activity of others – the manufacturer and the salesman – to make that conception real and receive proper distribution.

Today, in business, we are in an age of specialization. We work alone or with groups of specialists, of which the engineer is one out of many that are necessary in a complex business world. But, granted that an idea or design is born in the laboratory or drafting room, the business man tends to consider first his manufacturing staff and sales staff. There is where his capital investment will lie, his costs of production and his ability to distribute in competition. Rightly or wrongly, that is how he thinks. Upon manufacturing and selling hangeth all of the Law and the Prophets – no matter how you spell the last word.

Why? Because without manufacturing you have nothing to sell. Without sales a business is done for. Without these things together we would probably revert to an agricultural economy and the field of the engineer might be severely curtailed. It seems to me that everything else in business is subordinated to these two main functions. What useful purpose is served by industrial relations, purchasing, shipping, production control or even accounting if you do not have manufacturing and sales? Their success is essential. If you will examine the most successful businesses in the country, you will find that particular attention is given to the sales manager and the works manager and their staffs. Usually, also, these men, when successful, draw high salaries.

Next in line are two other important groups which are essential if a business is to continue. It is essential to have an accounting department to keep a record of the sales and costs and of the assets and liabilities, and, also, it is necessary to establish an engineering department to improve the product or to design new ones. As to the other aspects of any business, it is not my purpose to slight the importance of any of them. All appear to be necessary in varying degree.

Where does the engineer fit in this scheme of things? How can we change the attitude of the businessman who thinks first of his manufacturing department and sales department? How are we going to change this reaction to your own individual benefit?

Getting Started

Let us take the young engineer. Let us assume that he is employed – even that he may have had a few raises in pay and that he possesses ambition and a superior education, and cannot understand why his obvious talents are not more fully recognized. Somebody has said that in aviation all of us are screwballs to a certain extent but that engineers have carried the art of being screwballs to a high degree of refinement. Be that as it may, in this chance and silly remark I think we find the fundamental weakness of the engineer. He is a specialist in a rarified atmosphere. The prints of his drawing board are translated into physical things which he must envision first and then he must conceive

* Paper "What a Young Engineer Should Know" was presented at San Diego Section, May 5, 1947.

EXCERPTS FROM A PAPER* BY

Edmund T. Price

President, Solar Aircraft Co.

r Should Know

them as manufactured with machinery and processes at hand in his particular shop. Can he manufacture what he conceives or, when it had been manufactured, could he sell it?

Which Way?

Frequently not, and so at the outset, early in the career of our typical engineer, he must make up his mind as to whether he wishes to continue in engineering for engineering's sake or whether he wishes to gain a broader comprehension of the business world to become more valuable for his company and for himself.

This is one of the greatest of decisions in the life of any technically trained man.

By training and by experience he has hitherto led a relatively sheltered, if not inhibited, existence as far as business is concerned. He is in a professional capacity, operating with symbols of business, drawings, charts, mathematics, stresses and the queer names of measurements that sound as if they were taken from an alchemist's formulary. To the layman these are very mystifying. The engineer is a professional. Some engineers will wish to keep this professional rating by living a life apart from the problems of business and they may even pursue this up to or into the realms of pure science. That is a long, hard road. Its rewards are frequently only those of inner satisfaction over the success of mastering or even entering some new frontier of science. There may be others who wish larger, immediate incomes who are willing to leave the cloistered walls or ivory tower in which the professional man in pure science remains secluded. It is to this group that these remarks are addressed, with a word of warning that when you make plans to leave the ivory tower don't jump from the roof or out of the window. You are liable to break your neck!

You may recall years ago, in the early days of aviation, that some engineers started airplane manufacturing companies. Unfortunately most of these resulted eventually into tremendous losses to themselves and to their stockholders. For every Donald Douglas, and Ralph Damon, and MacLaddon, and Dutch Kindelberger, and others, there are dozens more who didn't make the grade. Those who have succeeded have fitted themselves over the years for the rough and tumble career of business by study and training.

What kind of training, you may ask. You can even argue along this line: "I have enough to do in keeping up my engineering reading and study let alone attending SAE meetings such as this one, which is not technical and which I attended only out of curiosity." I will reply that that is absolutely true, but, just the same, let us not forget that the basis of business is manufacturing and sales, and that engineering and accounting only round out the picture. Whether you agree with this conception or not – how much do you know about the other three major branches of business?

Broad Training Needed

Can you discuss with the production manager the merits or demerits of buying a new machine to do a certain piece of work? What will the savings be? How soon will the machine be paid for? In the current economic condition of the country is it worth while making this investment now? Or can you discuss and decide for the production engineer or superintendent or plant manager the best layout for floor space, arrangement of working tables, places where conveyor belts would pay and where they would not pay? Are you familiar with the latest methods of manufacture to accomplish certain results? Do you know why a company should buy a certain type of lathe and not one made by another manufacturer? Suppose the plant manager has said that his inventories are too high – would you know what is too high an inventory for your particular company? And if you did, what plans would you make to correct it? Why do you suppose the SAE Journal – an engineering magazine for engineers – includes articles on manufacturing technique? It is fundamentally to help

you broaden your base to make you more worth while to your outfit and to yourselves.

So much for the production department. Now let us take up sales. Suppose that the cost estimating department has determined that such and such an item or piece of goods should be sold for a certain price. Are you prepared, now as a member of the sales force, to present that price in competition, with competitive and perhaps lower prices submitted by other outfits, and still win the contract for your company because of its better service?

In the Salesman's Shoes

Or here is another problem in sales. Suppose you, as a salesman, know a purchasing agent quite well, and you and your wife have entertained him and his wife and you can regularly count on a certain volume of sales from the X company. Everything is fine until the Purchasing Agent gets promoted and your sales drop off because you can no longer obtain friendship orders from his successor. What is your next move?

Or have you as a salesman so conquered yourself that you are not afraid to go in on a new, cold prospect?

Or may we consider some problems in accounting. How many of you can read a balance sheet – the simplest, most essential accounting statement as to the condition of the company? Do you know how the Balance Sheet ties in with the Income Account?

Do you know what a reserve for depreciation is? What is a reserve? Do you think of it as so much cash that you take out of the bank and set aside? What do you know about taxes? Are you familiar with budgets? If so, how much should the engineering department cost your company? Would the company be better off with half the number of engineers, or twice as many? If you were faced with the necessity of a lay-off would you lay off a workman or an engineer? Why? Of course, it all depends on the situation, but suppose you had to make the decision.

All of these questions, at one time or another, are submitted to the heads of manufacturing or sales or accounting and, yet, many of you wonder why recognition in your chosen profession comes slowly. Maybe you feel that Bill, at the next bench, has gotten the breaks. Maybe you feel that there is unfortunate politics in your organization which gives undesirable preferment to a few. I am talking tonight to men with analytical minds. If those feelings occur to you it is probable you have not analyzed yourself, or the fundamentals which go to make up your personality. You have not seen yourselves and your engineering department in the broad perspective of a business which literally has thousands and thousands of questions to decide in manufacturing and sales and accounting besides those of engineering.

If pure engineering is your choice and you are satisfied in the refinement of the rarified air in which you work, by all means let me say nothing to dissuade you from this decision or from achieving what all of us want; namely, a life-work that satisfies and fulfills. But if you seek larger interests you cannot avoid some training in accounting, manufacturing and sales – now.

Except for one thing. More than at any time in the past, the demands of business today call for the services of men who can lead others.

To succeed, our young engineer must have warm sympathy with aims and ambitions of his fellowmen.

If you wonder at times regarding the future, and look forward to the time when you can sit in an upholstered chair dictating thousands of engineering change orders to your good-looking secretary, please bear in mind again that the engineering profession is highly specialized and that it does not, of itself, even remotely cover the broad field of business. Bear in mind that success for you in your outfit comes from having more than a speaking acquaintance with sales, manufacturing and accounting. Unless you go into training in at least one of these other subjects, your chances of real promotion are slim. It is also safe to predict that over a period of years if you do not get some training in two of these subjects, your chances of winning an important executive job in your company are even slimmer. And don't think you can by-pass this training with the statement: "Some day I'll run my own business." Because then the chances of success without this broader training are one in a thousand.

It all comes down to this! There is no aura surrounding the engineer. Even though he has had a technical training, wears corduroy trousers, uses a slide rule and smokes a pipe, none of these makes him a sacred cow. Corporation managers are most likely to retain engineers in their organizations whose abilities and judgment cover several fields and, in those cases, where a man also does his part in maintaining morale – one who shows signs of genuine leadership. Such a man is marked.

Hobbies Help Progress

Finally, take some creative work not allied with yourself or your business career and study it on the side. Make it a secondary life work. It makes no difference what it is as long as it is not subjective and provided that its magnitude is such that the possibilities are boundless.

And so our young engineer, having given himself even half the amount of analysis which he would give to the stresses imposed on a landing gear or the composition of an alloy, can genuinely ask himself and seek the solution to the question "What do I want most out of life?" No one else can answer the question for him nor even with finality point the way.

CYLINDER WEAR in Diesels

FROM PAPERS* BY

B. M. BERRY, Supervisor, Engine Lubricating Oil Division, California Research Corp.

A. J. BLACKWOOD, Assistant Director, Research Division, Standard Oil Development Co.

DR. L. A. BLANC, Assistant Director of Research, Caterpillar Tractor Co.

KARL H. EFFMAN, Research Engineer, Perfect Circle Corp.

and

NORMAN C. PENFOLD, Chairman, Mechanical Engineering Division, Armour Research Foundation

- *What causes it*
- *How it can be measured*

THE interior of diesel-engine cylinders is worn away by three separate actions: corrosion, abrasion, and scuffing. This conclusion is the result of 15 years of research carried out by scores of investigators to determine the effects of operating conditions, lubricants, fuel, and piston-ring design on cylinder wear.

The studies show that the relative importance of the three types of wear depends largely on the operating conditions. Comparison of the results of laboratory tests with those of service tests illustrates this fact. For example, in bench-test equipment other than engines, wear rates for certain oils at high temperatures may vary by as much as 500 to 1 in the extreme case and by 10 to 1 commonly. Under these conditions, the wear is essentially high-temperature corrosion. Some oils can inhibit this corrosion; others cannot.

If the same oils are subjected to field tests in identical equipment used for similar operations, the maximum variation in wear rates with different oils probably will not be more than 3 to 1, with 1½ to 1 covering the variations among most conventional oils. The corrosion experienced in the laboratory under high-temperature operation is masked by the introduction of low-temperature corrosion and abrasion by particles formed from combustion products as well as hard foreign particles entering through the air intake. Scuffing may or may not be a factor, depending on load and piston-ring design as well as condition of the lubricant.

The two types of corrosion wear appear to be due to two distinct causes – presence of sulfur in the fuel, and formation of carbonic acid on the walls at low operating temperatures.

Just how sulfur causes wear is not known. However, investigators have found that most of the sulfur in fuel is burned to sulfur trioxide. Presumably, the sulfur trioxide attacks the lubricating oil on the cylinder walls and forms resinous-like materials in the crankcase. Special lubricating oils have been developed which will give low wear rates even with high-sulfur fuels.

Wear is proportional to sulfur content and is independent of the type of sulfur compound present.

Sulfur in fuel causes wear at high or low operating temperatures, but its effect is sometimes overshadowed by the carbonic-acid corrosion in an engine which passes frequently through low operating temperature ranges.

During shut-down and warm-up, the temperature in the cylinder is below the dew point, and mois-

* Berry paper, "Influence of Lubricating Oil on Cylinder Wear"; Blackwood paper, "Fuel Properties Affecting Diesel Engine Wear"; Blanc paper, "Effect of Engine Operating Conditions on Cylinder and Ring Wear"; Effman paper, "Cylinder Wear – Piston Rings"; Penfold paper, "Instrumentation for Cylinder Wear Measurement." These papers were presented at the SAE Summer Meeting, French Lick, Ind., June 5, 1947.

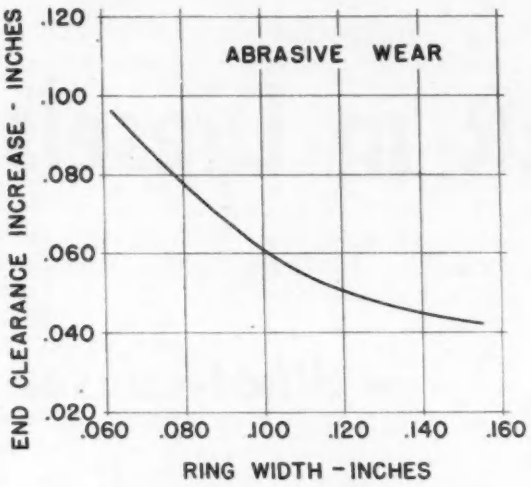


Fig. 1 – Effect of piston-ring width on abrasive ring wear as shown by variation in end clearance

ture condenses on the cylinder walls. Carbon dioxide, produced by combustion of the fuel and oil, unites with the moisture to form carbonic acid, a corroding agent which attacks the walls. Corrosion products are removed by the piston rings, and the area is left free for renewed attack.

The wear rate under low-temperature conditions depends partly on the ability of the lubricating oil to maintain a protective film on metal surfaces so that corrosive agents do not contact the metal.

Resinous materials formed by sulfur trioxide – the sulfur coming from the fuel – plus lubricating oil may, at the high temperatures associated with engine operation, harden to form varnish or coke. It is possible that some of the wear is then due to abrasion by hard carbon. Also, deposits of carbon in the ring grooves may increase metallic friction.

Corrosion-type wear due to sulfur seems to be the fuel's chief contribution to wear. Other fuel characteristics influence wear to some extent. It appears that viscosity and volatility may have some effect on wear. At least, investigators report that higher viscosity or average boiling point result in a dirtier engine. They base their conclusions about the bad effect of high viscosity and volatility on wear, on the concept that poor combustion resulting in a dirty engine will eventually result in high wear rate.

Cetane number, specific gravity, and average volatility are interrelated for normal fuels. As far as can be determined, cetane number and specific gravity have no independent effect on wear. Nor does nitrogen have any perceptible effect on wear. Stocks having high carbon residues and ash contents accelerate wear, but in fuels for high-speed diesels both are too low to be effective.

The research which has been done on the effect of fuel properties on wear has been done on small high-speed diesels with fuels which are stable and free of water, corrosives, abrasives, and residual materials. The same effects probably apply quantitatively to lower-speed diesels with good fuels.

Abrasive Wear

When it comes to abrasion, cylinder wear and ring wear usually go hand in hand. Anything that reduces ring wear will reduce cylinder wear.

The resistance of rings to abrasive wear is a function of ring width. This observation was confirmed by a test of rings of various widths in a water-cooled single-cylinder engine of 3½-in. bore and 5-in. stroke. All rings were the plain compression type and made of the same material. All had the same wall thickness and free gap opening, so that they exerted the same unit pressure against the cylinder wall. At three different points during a 7-hr running schedule, 1 g of graded dust was injected into the intake port. The engine was operated at 2500 rpm at 45 psi bmep during the last 6½ hr of the test.

Ring wear was measured by the increase in end clearance. (As a ring wears, its radial pressure forces it to spread in order to meet the cylinder wall, and the end clearance increases.) Fig. 1 shows variation of increase of end clearance during the test as a function of ring width. If abrasive-wear resistance were the only consideration in the selection of piston rings, the widest possible rings would be the best.

Several methods are used to make ring faces harder in order to increase resistance to abrasive wear. Chromium plating the face will reduce the wear rate to 20 or 25% of that with grey iron rings of the same section and unit pressure, dust tests in a laboratory engine indicate.

Abrasion resistance can be improved slightly by going to the considerable expense of surface hardening rings made of a special cast iron. Fully hardened alloy cast-iron rings show promise of being less costly and more practical.

The engine operator who is concerned with cutting down abrasive wear must depend on the fuel suppliers to give him fuel free of grit-forming constituents and on the engine manufacturer to install wear-resistant piston rings. One thing the operator can do himself is to maintain air cleaners and filters in good condition and to change oil at the proper intervals. This will minimize the amount of abrasive material entering the cylinder.

Scuffing Wear

Scuffing of cylinder walls and piston rings usually occurs during break-in or during over-loading of an engine without adequate warmup. Such conditions as high cylinder temperatures, high rubbing speeds, high gas loads, localized high pressure areas due to cylinder distortion, and dilution of lubricating oil with fuel cause metal-to-metal contact between cylinder and ring, and promote scuffing.

concluded on page 43

SURVEY FINDS: "Chrome Plating Well Suited to Piston Rings"

BASED ON A PAPER* BY **H. O. Mathews** Manager, Fleet Operations, Standard Brands, Inc.

RESULTS of a survey of fleet operators and piston-ring manufacturers on the merits of chrome plating in reducing vehicle wear boil down to these conclusions:

1. Chrome plating is satisfactory in reducing wear of chassis parts, but uneconomical for reclaiming worn parts;

2. Chrome-plated piston rings are satisfactory according to tests, but failure of other parts may nullify their full potential value;

3. Chrome-plated cylinder walls are not fully adequate and, unless sleeves are used, cost too much;

4. Chrome-plated rings and walls will not work well together;

5. Fleet operators would benefit from the use of chrome-plated rings in original equipment.

Vehicle parts are chrome plated for emergency or economy reasons. Emergency use implies chrome plating for reuse because parts are not available and cost is not a factor. When chrome plating parts for economy, the saving in wear and operational expense must more than justify the cost of the plating.

Emergency chrome plating deserves some discussion because of the experience gained and because of the emergency repairs that led to further economies.

Wartime shortages of vital tank-engine materials forced the adoption of emergency methods to reclaim worn cylinder barrels. Rebuilt by the Porous Krome plating method to their original size, these barrels were reused as new parts. Tests indicated considerable wear reduction, even under dusty conditions. While cost analysis data are not available, this technique saved more than 50% in the cost of new cylinder barrels for these engines.

A similar piston-pin shortage inspired the chrome plating of worn pins. They were reground to a predetermined undersize and chrome was added to refinish them for use in all types of military automotive engines. Although this produced satisfactory results, it proved quite expensive compared to new piston pins and was abandoned as soon as possible.

The maintenance superintendent of one of the largest bus fleets in the country advised that he tried chrome plating connecting-rod journals, pistons, piston pins, and king pins during the war and afterwards while parts were short. He also reported increased life with chrome-plated connecting-rod journals and crankshafts of two-cycle diesels. He found it more satisfactory than metallizing for his particular operation. But since cost was the main objection to this process, it was used only for emergency repairs.

An operator of a large fleet of heavy-duty equipment related that he tried hard-chrome cylinder sleeves in a Cummins Model HB 600 engine. The test lasted only 20,000 miles because a rod broke and ruined the engine. The sleeves, checked at that mileage, were slightly scored. Black soot covering the piston indicated a blowby condition. Cylinder wear did not exceed 0.0025 in. The operator felt the engine was operating with borderline lubrication, particularly at starting.

These applications cover most of the emergency chrome-plating uses employed by a majority of the fleet operators contacted. Few, if any, of these plating uses were economical. But since these applications – except for hard chrome – operated satisfactorily, operators would welcome harder finishes approaching chrome plating on all such wearing surfaces.

Chrome plating for economy seems to be con

*Paper "Chrome Plating to Reduce Wear – A Survey of Fleet Operators' Experience," was presented at SAE National West Coast Transportation & Maintenance Meeting, Los Angeles, Aug. 21, 1947.

fined to piston rings. Two conclusions axiomatic in this work are (1), chrome-plated rings and cylinders do not go together and (2), only the top ring should be chrome plated.

Several operators using installations with chrome-plated top rings reported adequate power and oil consumption. Little is known about wear reduction from actual experience, but test data appear to be conclusive.

One operator using chrome-plated top rings – some porous and the others hard chrome – in 28 buses estimates a 10 to 20% improvement in oil consumption after about 50,000 miles of operation in one year. But no information on wear is available.

Three major piston-ring manufacturers were contacted in the search for test data. These as well as others have been following use of chrome-plated rings with unusual interest. Extensive tests in their own laboratories and on proving grounds yielded conclusive evidence in favor of chrome-plated top rings. Their comments are given below.

■ *One Piston-Ring Manufacturer Says . . .*

"Whereas we are following many installations of chrome plated rings and chrome plated bores, the data up to date are not complete enough that we would care to make any specific statements.

"There is undoubtedly an improvement of ring life under certain operating conditions; for example, where dust conditions are severe, it is very marked. Bore wear is affected beneficially by the reduced ring wear. These facts are substantiated by the data on military aircraft engines.

"The data now needed from truck, bus and tractor experience is to justify the cost of chrome plating. The chrome plated ring is inherently expensive. The ring has to be very well made and requires many operations over the unplated ring. To short-cut these operations is dangerous. It is not a matter of increased production to reduce costs; during the war the production of these rings was probably greater than what it ever will be in peace-time on any one size.

"In justifying the costs of rings, other parts of the engine have to approach the ring life. If an engine has to be torn down for any other cause, the cost of replating rings is negligible; but, if the engine fails between any period of overhaul because of rings, the cost of tearing down the engine is chargeable against the ring installation entirely and makes this cost very high. The premium ring must be able to span several overhaul periods to warrant itself."

■ *Another Manufacturer Reports . . .*

"The type of chrome adopted in the United States was the so-called channel or plateau. The size of these plateaux was specified along with the depth of the channels. This type of chrome with its fairly large plateau operated most satisfactorily in aircraft engines and certainly accomplished the salvaging purposes for which intended. In Canada the chrome was of the smaller plateau type but also gave a very satisfactory performance.

"The question discussed at many times through this period was the benefits of chrome plating the face of the ring versus the benefits of chrome plating the cylinder, as far as operation was concerned. In other words, we were constantly working on the future practice after the salvaging had been accomplished, and trying to determine whether new cylinder sleeves might be chrome plated. Performance was good and the life of the parts increased in both cases.

"Chrome-plated rings would not function in chrome-plated cylinders, so it was important to know which way the industry was going to move. I think the expense of chrome plating sleeves versus the expense of chrome plating rings has finally settled this matter.

"The chrome-plated ring will give a very good account of itself, and is particularly desirable in heavy duty engines. . . .

"There is still somewhat of a question as to the best type of chrome. As certain engine manufacturers have put it, the best type is the type that their particular engine likes the most. Some engine manufacturers specify a hard chrome with very little etching or porosity. In other cases manufac-

turers specify a rather fine grain chrome of the pin-point or rat-tail variety, with considerable etching or porosity.

"In the replacement field we more or less attempt to use the more porous material in smaller light-weight engines, and the less porous material in the larger, slower-speed, heavy-duty engines.

"We have had many excellent reports from the field showing anywhere from three to five times the life with ring sets including a chrome-faced ring in the top groove than we have with regular ring sets without a chrome-plated ring.

"It is necessary to use a chrome-plated ring only in the top groove, as this ring is the one that receives the burden of the wear, operating in the dirtiest part of the motor and the part of the motor that is most affected by acids.

"We find that the chrome ring not only lasts several times longer than other rings but also increases the life of the lower rings on the piston as well as reducing the wear on the cylinder walls."

According to a Third Manufacturer . . .

"Experience has proved that the wear rate of compression rings may be reduced 80% by chromium plating. A similar reduction in cylinder-wear rate is usually experienced. Cases where these figures apply have been observed in both dusty and clean operating conditions. Of course, the increase in effective life is much more valuable and much more noticeable in engines operating under abnormally dusty or dirty conditions.

"The reduction in wear rate referred to above is an average of general experience over many applications in a wide variety of engines under widely varying operating conditions. A specific comparison of the wear rate of plated versus unplated rings is charted in Fig. 1. These test data were obtained in the laboratory by injecting small quantities of a standardized and highly-abrasive type of test dust into a single-cylinder test engine. It agrees remarkably well with general experience in spite of the fact that the test was of the accelerated laboratory type.

"Chromium plate acts in two ways to reduce wear. The chromium, being extremely hard itself, was high resistance to abrasion and, in the process of digesting abrasive material, reduces the size and sharpness of the abrasive so that its cutting ability is lessened. The hard surface of the chromium plate also has less tendency to pick up or become loaded with abrasive itself, which contributes to reduced cylinder wear.

"General experience has also indicated that chromium plating the faces of piston rings adds considerably to their resistance to scuffing. Scuffing is the result of actual welding of the material of the ring face with the material of the cyinder. It well may be that the higher melting point of chromium (2900F) as compared with that of gray iron (2200F) is a contributing factor. The lower coefficient of friction of chromium is probably also helpful."

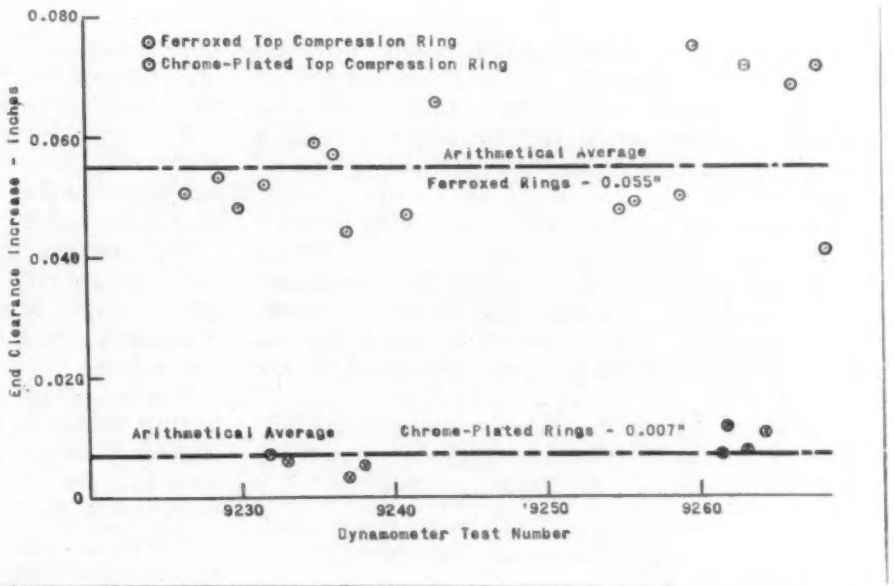
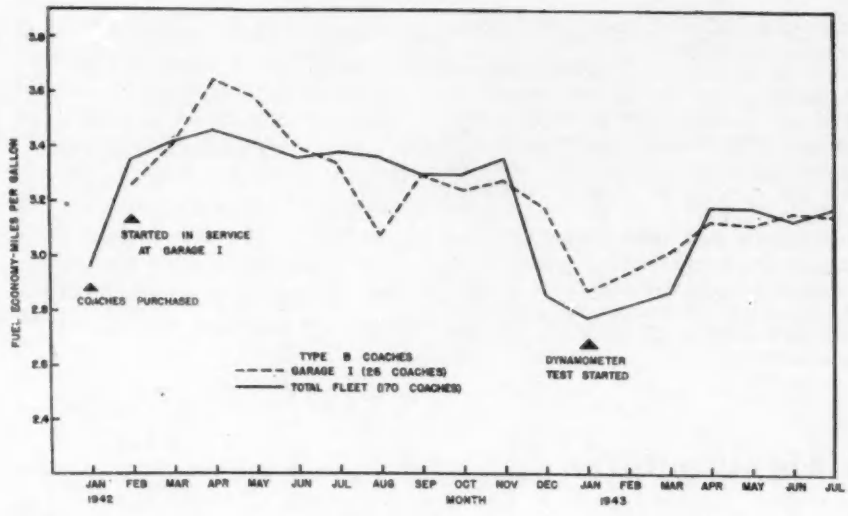


Fig. 1 – These test data testify to the superiority of plated over unplated rings in wear rate. These results were obtained under controlled dynamometer test conditions. Highly abrasive dust was injected into a single cylinder engine. End clearance increase measured is indicative of wear rate

CHASSIS Impels


FUEL ECONOMY-MILES PER GALLON
STARTED IN SERVICE AT GARAGE I
COACHES PURCHASED
TYPE B COACHES
GARAGE I (26 COACHES)
TOTAL FLEET (170 COACHES)
DYNAMOMETER TEST STARTED
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
1942
MONTH
1943

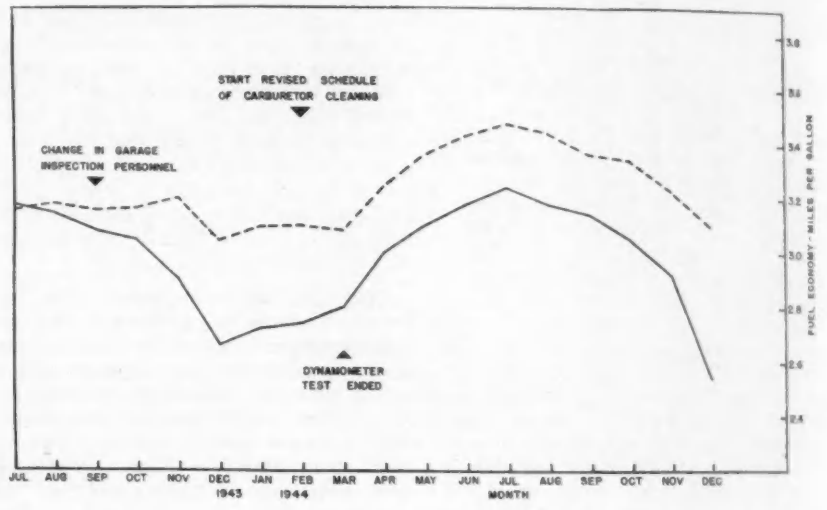

START REVISED SCHEDULE OF CARBURETOR CLEANING
CHANGE IN GARAGE INSPECTION PERSONNEL
DYNAMOMETER TEST ENDED
FUEL ECONOMY - MILES PER GALLON
JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1943
1944
MONTH

Fig. 1 – Fuel consumption, these St. Louis Public Service records show, is generally greater in winter than in summer. Engine idling during cold weather to prevent freezing contributes to lowered fuel economy. But regardless of the season, these curves reveal, a dynamometer program induces economy-making maintenance in the shop

A TWO-YEAR chassis dynamometer program with St. Louis Public Service Co. buses proved that "indoor road" testing can reduce both fleet fuel consumption and maintenance by disclosing vehicle defects under closely-duplicated operating conditions.

This test program yielded the following results:

1. Fuel economy improved 8 to 10%. Better carburetor maintenance, prompted by dynamometer use and study of fuel consumption records, was mostly responsible. Based on today's costs, this saved $125 to $150 per year per coach of this type.

2. Average number of driver complaints decreased 12 to 15%. The dynamometer was most effective in reducing "no power" complaints.

3. Analysis of road-call data showed an average reduction of about 20% in the number of road calls on a per-unit basis.

The dynamometer alone cannot bring about these results. A number of influences have considerable bearing on the improvements a fleet operator can realize.

Maintenance quality reflects the type of shop and supervisory personnel. Inadequate records and improper analysis can lead to false evaluation of chassis dynamometer effectiveness as a maintenance tool.

Engine idling necessitated by outside storage during winter months has a marked effect on fuel consumption which cannot be overcome by engine tune-up. But the greatest single factor in fuel economy is the level of carburetor maintenance.

The St. Louis Public Service and Ethyl program also showed that general mechanical condition of

* Paper "Utilization of Chassis Dynamometers and Maintenance Records Analysis to Improve Operating Economies," was presented at SAE Summer Meeting, June 2, 1947.

DYNAMOMETER Fleet Operating Economies

BASED ON A PAPER* BY

ERROL J. GAY Manager, Commercial Engine and Fleet Division, Ethyl Corp.

and HENRY T. MUELLER Technical Service Department, Ethyl Corp.

an engine must be considered in relation to its effect on the overall operation. Engines that accumulated high mileage without overhaul cannot be expected to perform on a par with low-mileage or rebuilt engines.

To achieve these operating economies, the chassis dynamometer was put to work in a number of ways.

Testing each coach after regular pit inspection, the dynamometer served as a general inspection tool. As a spot-check device, the dynamometer tested a few coaches of each type – selected at random – to check the caliber of floor inspection methods. It also aided in the determination of the adjustment standard for the entire fleet on items such as ignition timing, valve lash, spark-plug gap settings, and carburetor calibration.

Checks were made to note whether chassis dynamometer-tested vehicles with proper ignition timing and carburetor calibration showed any improvement in fuel economy over those units subjected to routine fleet maintenance only.

Throughout the investigations the relationship between the "design factor" and maintenance simplification was constantly watched. Continuous comparison of day-to-day and month-to-month

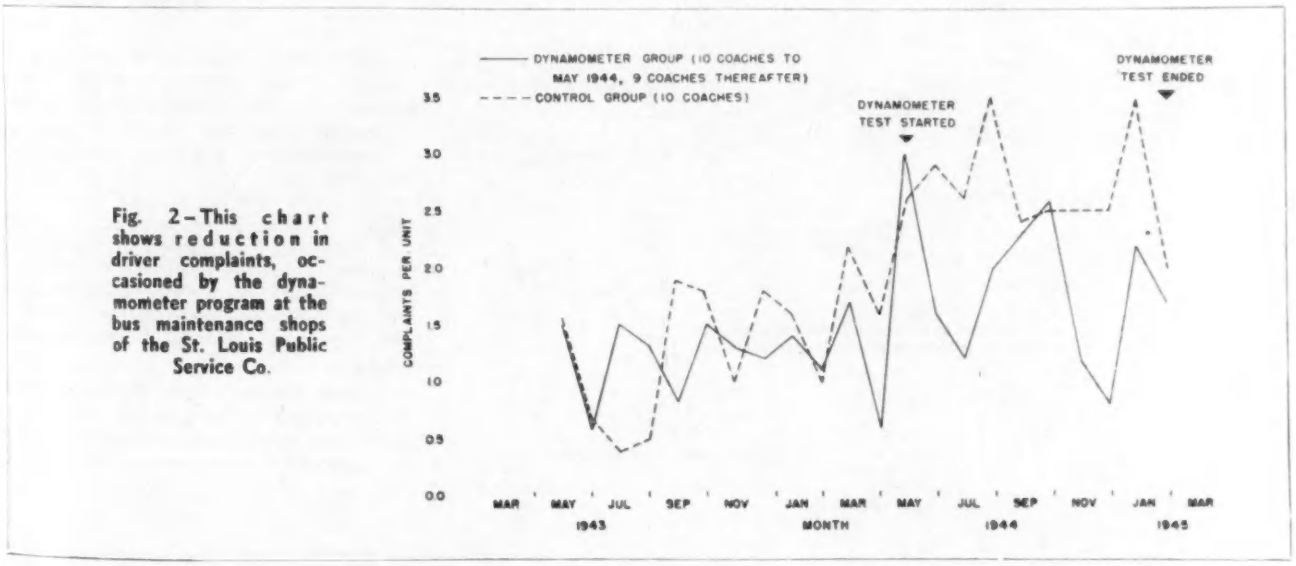


Fig. 2 – This chart shows reduction in driver complaints, occasioned by the dynamometer program at the bus maintenance shops of the St. Louis Public Service Co.

records helped determine the trend of the influence many variables had on fuel economy, driver, complaints, and road calls. Findings disclosed by the planned and "extraneous" investigations should be of interest to both fleet operator and design engineer.

The test had not been in progress very long when it became evident that thorough examination of past mileage records was important. For example, most fleets – particularly those in the north – show seasonal variation in fuel mileage. This is demonstrated by the curves in Fig. 1. It is evident why changes made in April might indicate optimistic results while those in September might seem to affect mileage adversely.

These charts also show the effect of changing inspection personnel and the consistently higher mileage of the test fleet once the dynamometer program had taken hold.

Like many fleet operators forced to store their equipment outside due to lack of inside storage space, St. Louis Public Service had to keep its vehicles from freezing during off-duty service. This compelled the company to idle its gasoline-powered buses at about 700 to 1000 rpm when parked out-of-doors for extended periods. Fig. 1 shows what such practice does to fuel economy.

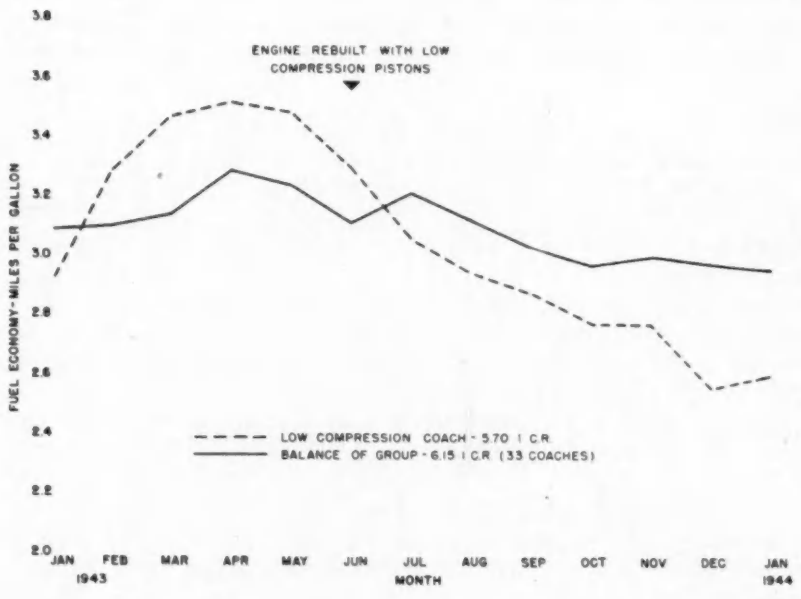
Checks taken during February and March, 1945, showed idling to represent 35.5% of total engine operating time. Since these engines consume 1 to 1½ gal of gasoline per hr when idling at 700 to 1000 rpm, 140 to 210 gal per coach per month were consumed for the months of February and March. Mechanical condition or engine adjustment have no control over this factor.

During the test period driver complaints were definitely reduced. Fig. 2 compares driver complaints for a group of dynamometer coaches against a control group at the same garage. Dollars-and-cents assessment of savings accrued by a lowered rate of driver complaints and road calls is difficult. Certainly frequent road calls rapidly dissipate good will, especially with coaches. And driver complaints will likely bring about mishandling of equipment – intentional or unintentional.

Early in the program it appeared that a No. 27 main jet in the carburetor instead of a No. 25 jet substantially increased power. But subsequent fuel economy figures indicated a considerable loss in economy. Reinstallation of the No. 25 jets and a thorough carburetor cleaning lifted fuel economy even above the original level. Investigation of this situation showed that carburetor efficiency began to drop after 20,000 miles.

But exhaust-gas analysis during routine dynamometer tests did not detect this condition, indicating that the large amount of idling and coasting time lowered fuel economy since the enrichment gummed up the carburetor air passages. These results led to the institution of a carburetor-cleaning program each 20,000 miles that maintained the improvement in economy. Urban truck and bus fleets can profit from this experience.

Incidentally, carburetor removal for cleaning and rebuilding points up a "design factor." So



How Chassis Tests Curbed

The power output of one of the coaches being tested was 10% below normal, despite repeatedly unsuccessful tune-ups to improve the engine.

Investigation disclosed that this engine had been rebuilt with pistons 0.45 ratios lower than standard compression ratio. This was necessitated by a wartime shortage of standard pistons. Six coaches were built up with this lower piston ratio and all six were found to deliver approximately 8 to 10% less rear-wheel power than the standard units.

Direct effect of this on fuel economy is shown in the chart at left which compares one vehicle with the remainder of the standard compression ratio group

many items must first be removed that the labor to remove and install a carburetor can add up to 1 hr per vehicle. An operator might hesitate to do such work unless sizable fuel savings are apparent. He may remove the carburetor only when repairs are necessary.

Dynamometer Trouble-Shooting

Tests of one bus model disclosed a cylinder-to-cylinder variation in ignition timing as high as 10 deg. It made control of the knock level impossible, except by adjusting the basic ignition setting to the cylinder having the highest advance.

Cause of this variation was finally traced to an auxiliary shaft driving the distributor, fuel pump, and governor. Shock loading from fuel pump to shaft was transmitted to the distributor, oscillating the advance mechanism. This oscillation progressively worsened as pump-imposed shock loading and side thrust on the shaft caused abnormal shaft-bearing wear.

Installing a new shaft and transferring the fuel pump to a point where it was driven directly by the camshaft almost entirely eliminated the variation.

In this connection it might be well to point out the merits of making flywheel markings easily accessible as well as those of providing a sufficiently-large inspection hole in the flywheel housing to permit flywheel calibration each 120 deg. If the manufacturer would mark the flywheel in this manner at the factory, the maintenance man could check the engine's distributor advance characteristics, taking into account distributor drive variables which may not show up in a bench test.

While the chassis dynamometer is not a substitute for a good preventive maintenance program, it will stimulate a desire to establish good maintenance by the evidence it uncovers.

At both the St. Louis Public Service garages using chassis dynamometers, accuracy of adjustments made by shop personnel improved noticeably. These men soon became interested in the use of instruments and eventually asked to use some of the specialized instruments to improve the accuracy of their work.

Pride of accomplishment is a great incentive motive. Herein lies a major value of the chassis dynamometer in a maintenance shop.

Study of improved engine maintenance practice brought into sharp focus the inaccessibility of engine components, which largely offsets operating economies such a program achieves. Easy-to-remove carburetors and valve covers and more accessible fuel pumps, ignition wiring, and spark plugs would help the fleet operator realize the potential gains stemming from sound maintenance.

This work does not indicate the size of a fleet – in terms of initial and operating costs – in which a chassis dynamometer is justified. A well-built unit should last indefinitely; its initial cost can be written off in five to seven years. Before making a final decision, each fleet should examine its own situation and consult with fleets operating their own units.

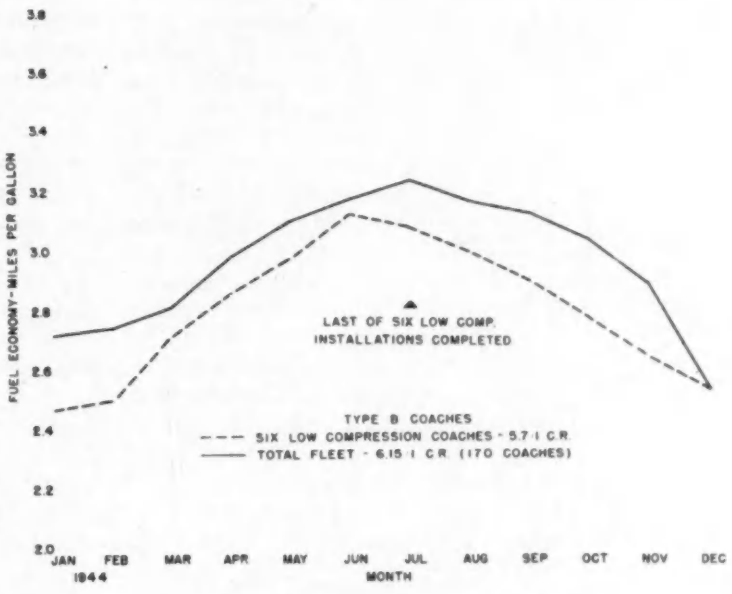
Dynamometer a Fuel Waste

operating out of the same garage. The chart at right compares the six low-compression coaches as a group with the remainder of the standard-ratio group operated by all garages.

Average mileage loss is 8% – representing over $100 per bus per year for these particular coaches.

Significance of these figures is important to all fleet operators. They vividly illustrate the importance of maintaining compression ratios at factory standards.

Also shown is the significance of taking advantage of improvements in gasoline antiknock quality, wherever possible, by manufacturer-approved increases in compression ratio.



AUTOMATIC PROPS Improve Light Plane

BASED ON A PAPER* BY **JOHN D. WAUGH**
Public Relations Representative, Aeromatic Propeller Department
Koppers Co., Inc.

IMPROVED performance in the form of reduced take-off run, increased rate of climb, and higher cruising speed is attained with the automatic, variable-pitch propeller operating at constant speed, as compared with the fixed-pitch design.

The variation in pitch is accomplished automatically by means of a mechanism using the change in thrust as the motivating force, as this force possesses both sensitivity and stability and requires only two moving parts (the blades) to give automatic operation.

The use of thrust as the principal pitch-changing force was determined only after considering all possible means of motivation.

Torque was considered, for instance, but was found to be infested with fluctuations, which would entail mechanical compensation in addition to expensive linkage from the engine shaft to the blades to control.

Servo mechanisms operated by an impeller in the airstream are quite expensive because of complicated mechanism and because they would have to be developed extensively to eliminate irregular operation due to inertia effects.

A variable-pitch propeller using auxiliary power requires airplane or engine fittings and cockpit controls that are eliminated in the present design, which operates entirely by natural forces inherent in a rotating propeller.

Two-position operation by automatic means was not considered at all because there is no point in having two stages when as much mechanism is required as for a full range of pitch variation.

Principle of Operation

Fig. 1 shows how the operating forces on the blades change pitch automatically to keep the propeller at constant speed as the conditions of flight change.

As the propeller is brought up to speed with the airplane stationary, the blades automatically go to low pitch, due to the large thrust moment and the blade centrifugal twisting moment. After the air-

* "Evolution of an Automatic, Variable-Pitch Propeller" was presented at the SAE National Personal Aircraft Meeting, Wichita, Kans., May 1, 1947.

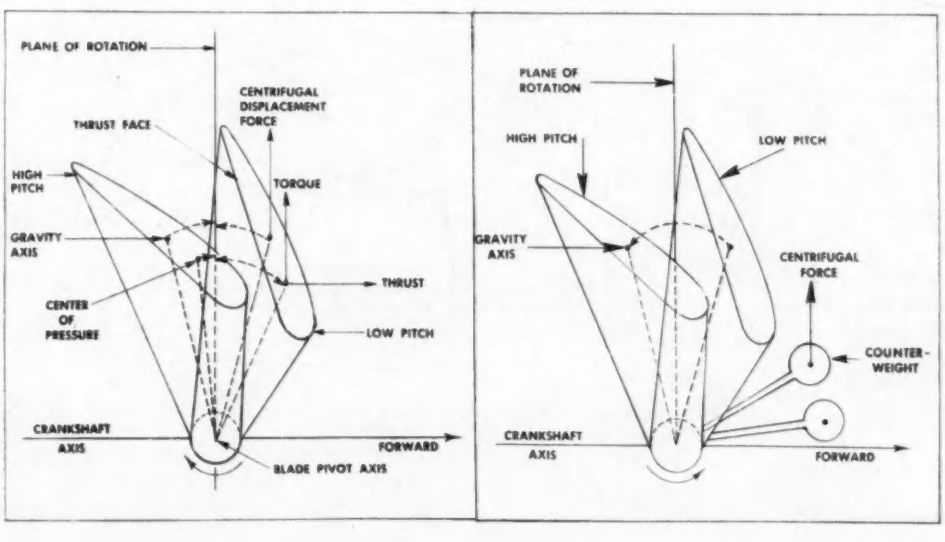


Fig. 1 – Characteristic operating forces of automatic propeller – left: tip view of blade through center of pressure; right: tip view of blade and counterweight assembly

Performance

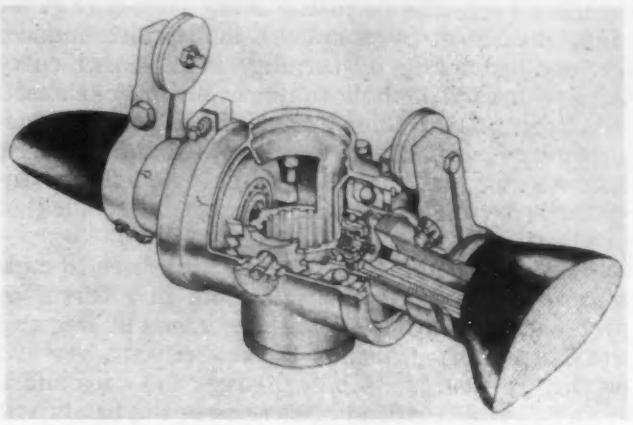


Fig. 2 – Cutaway view of 20-spline automatic propeller

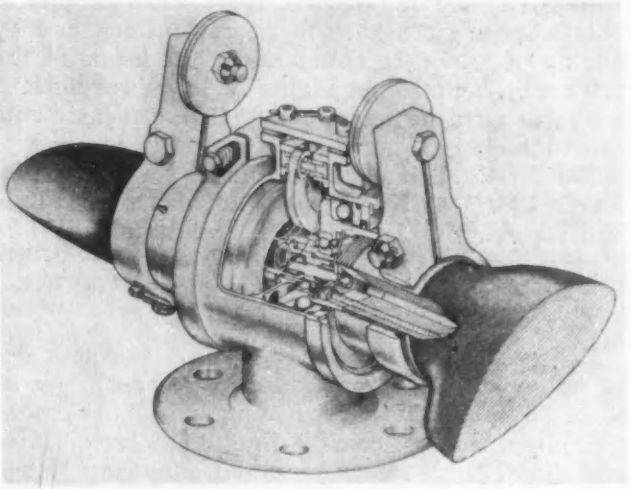


Fig. 3 – Cutaway view of flange model of automatic propeller

plane takes off and its speed increases, the thrust moment drops off, while the mass moments increase, causing pitch to increase enough to give a constant propeller speed.

Equilibrium is dependent on a balance between pitch-increasing and pitch-decreasing moments, as follows:

1. The thrust moment, acting on the center of pressure of the blades, tends to reduce pitch.
2. The blade centrifugal twisting moment, tending to rotate the blades about the center of pressure, tends to reduce pitch.
3. The centrifugal displacement moment tends to keep the blade in the plane of rotation. Torque also tends to keep the center of pressure in the plane of rotation.
4. The counterweight centrifugal moment tends to increase pitch at normal angular positions of the blade.

Thus, for any given power setting and flight speed, the equilibrium point results in the correct pitch angle. As speed changes because of a change in the attitude of the plane, the resulting unbalance of forces changes the pitch until equilibrium is again established. It has been possible to attain a balance of forces such that constant propeller speed to within $\pm$ 25 of rated rpm results, making rated hp available from take-off to the critical cruising altitude.

To obtain sufficient differential of forces to assure sensitivity and stability, the blades are placed at a 2 to 10 deg lag or construction angle (the angle the blade centerline makes with the blade pivot axis in the plane of rotation).

The pitch-decreasing thrust and centrifugal twisting moments are counteracted by the centrifugal displacement moment. The effect of the latter can be varied by a change in the phase angle, which is the pitch angle when the blade is in the plane of rotation.

The value of the counterweight centrifugal moment is determined by the distance of the weight, composed of the arm and added weight, from the crankshaft centerline and the plane of rotation. The counterweight acts as a displaced mass that, affected by centrifugal force, tries to align itself with the plane of rotation. In this plane or aligned with the crankshaft centerline, the effect of the counterweight is zero. The maximum moment is exerted at the 45-deg position.

Different regulation characteristics can be obtained by angular adjustment of the arm or a change in the weight. The flexibility of these and other adjustments permits sufficient regulation to cover a wide range of designs without modification of standard hub components.

The propeller has been designed for splined shafts up to 60 splines, and also for flange shafts. Fig. 2 shows a 20-spline design developed for engines of 155-245 hp.

A small gear is used to connect the two blades and thus provide a means of synchronization for, although, theoretically, the blades should act the same way, it was found that during curved flight, aerodynamic and gyroscopic forces would cause vibration by moving the blades out of phase.

The spring shown in the center of the preload

bearing keeps the preload locking splines engaged until depressed by a splined tool, which induces preloading merely by turning. A lubricant entry is provided by the hollow synchronizer gear shaft.

After the variables for a given plane-engine-propeller installation are determined, a lock screw indexes the blade, counterweight, and flange together, the hole for this screw being drilled in production.

Balance is attained by adding lead discs to cups in thin steel strips encircling the hub barrel at each end. The propeller is then turned 90 deg and the bands shifted around the barrel until vertical balance is secured. A bolt through the cups and a spring against the load discs secures the bands and keeps the discs from moving.

Field adjustments can be made quite simply by adding or removing discs of the counterweights to obtain lower or higher flight revolutions and by adding or removing shims under the heads of the pitch stop bolts to get higher or lower revolutions when the airplane is stationary. These adjustments can be made in 10 min.

Total weight of a unit designed for the 185-hp North American NAvion is 53 lb, of which 34 lb is hub weight and 19 lb is the weight of the two blades.

Flange Series

Representative of the flange series is a unit designed as shown in Fig. 3, which is for engines of 65 to 150 hp. The welded cylindrical hub, extension piece, and engine mounting flange are an integral unit. Flange retention is by a snap ring. Other features include large ball thrust bearings, radial journal and preload bearings, and lubricant seals.

Synchronization of blade movements is attained by the link arm method, which consists of two curved arms fitting pins on the flange butts and having a common wristpin in a phenolic piston, permitting reciprocal motion in a cylinder integral with the front of the hub.

Shims under the flat plate covering this cylinder and the discs comprising the added weight of the counterweight provide for the only two adjustments ever necessary in the field. Since the plate limits the forward travel of the synchronizer piston as the blades go to low pitch, shims added or removed govern the rpm of the stationary airplane.

The only adjustment to change flight rpm is, then, the counterweight added weights, just as for the spline series.

Comparative performance tests were made with a 100-hp Piper Super Cruiser. At the end of 5 min of climb, the airplane with the automatic prop had gained an altitude 13% higher than the airplane with the fixed-pitch propeller. Cruising at the same engine speed, the automatic propeller gave 5.5% higher cruising speed.

Total weight of the present flange propeller for 150 hp with 76-in. diameter blades is 32 lb, of which 16 lb is hub weight and 16 lb is blade weight.

Blade Retention

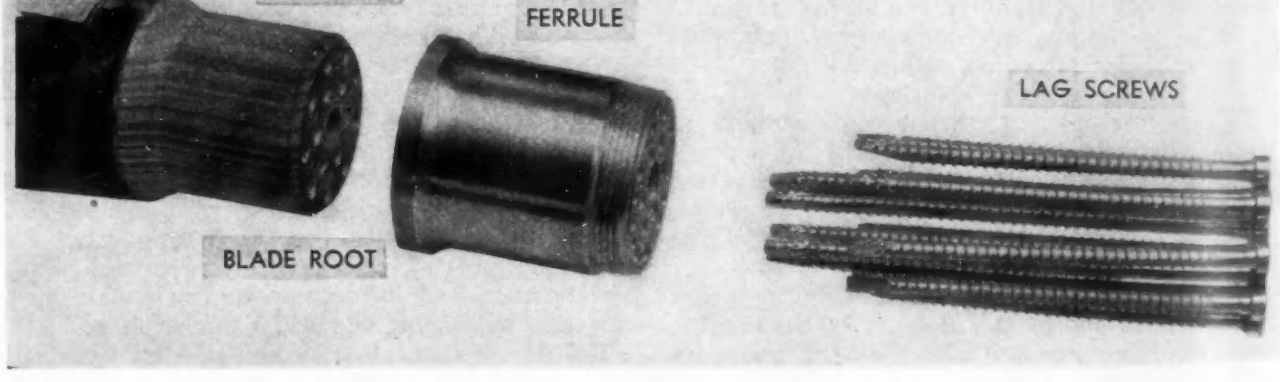
Many designs were tried before a satisfactory method of retaining the blade in the hub was evolved.

Finally, a system developed at Wright Field was tried. It proved to be superior to any method used previously either in this country or abroad.

Laminated maple composed of 1/10-in. thick veneers splayed alternately at an angle of 15 deg to the blade centerline is used for the blade root. Thermal-setting synthetic resin is spread between the veneers and the block is subjected to radio heat in a platen press exerting moderate pressure. The resulting material has exceptional strength and stability. The alternately splayed veneers contribute to the strength of the blades and permit thin outer sections.

The moisture absorption tendency is maintained essentially constant by a cellulose nitrate plastic sheet 0.040 in. thick applied over the whole blade surface in a pliable state and cured to provide a hard, smooth surface. Fig. 4, which is an exploded view of the present retention system, shows how the plastic sheet joins the edge of the ferrule. Preformed monel metal tipping is applied over or

Fig. 4 – Retention system of ferrule and lag screws



recessed in the plastic and retained by conventional screws and rivets.

Lag screws of different lengths (so their ends are distributed over different cross-sectional planes to diminish localized stresses) are used to screw the ferrule to the blade root. This method of retention has exceptional strength and is a straightforward method of manufacture.

Metal blades do not fit into the present light plane field because of high weight, initial cost, and secondary cost.

In this connection it is interesting to note that in case of accident, less damage is caused when the wood propeller is used, for the blade snaps off without doing any more hub damage than cracking the radial preload bearing.

If a metal blade is used, however, the shock of contact ruins most of the hub components, damages the hub, and could conceivably even affect the engine crankshaft. This, of course, applies only to light planes, for large aircraft are quite a different matter.

CYLINDER WEAR IN DIESELS

continued from page 32

Tests made following the Army AXS-1552 procedure for measuring scuffing tendencies of Heavy-Duty oils show that some lubricants are less conducive to scuffing than others. Volatility of the base oil is probably the most important factor.

The resistance of the piston ring to scuffing wear – unlike resistance to abrasion – varies inversely as the width. The narrower the rings, the less the scuffing wear.

Chromium plating piston-ring faces will improve scuff resistance as well as abrasion resistance. Plating of compression rings allows the use of narrow, scuff-resistant rings, usually with better abrasive-wear resistance than wider grey iron rings give.

Grooving faces of either grey iron or chromium-plated rings and refilling grooves with another material protects against scuffing. The grooved rings have been used with outstanding success in diesel locomotive applications. However, with this construction, clean intake air is essential to long service life.

Various coatings are available for application to new grey iron rings as extra protection against scuffing during the break-in period. The coatings are useful where only very small amounts of abrasive are present and conditions in the engine offer no scuffing problem after the rings are seated.

With scuffing, ring wear and oil consumption are too great to be tolerated in normal operation of any diesel engine.

Techniques of Measuring Wear

Interesting byproducts of cylinder-wear studies are the measuring techniques developed. Changes occurring in cylinder dimensions over reasonably short test periods are of such small magnitude that instrumentation must be capable of indicating minute changes accurately. Measurement is complicated by irregularity of the wear pattern and by distortion resulting from mechanical and thermal stresses. Real ingenuity has gone into the solution of these problems.

The dial indicator has been used in special mountings which enable it to be moved in a direction parallel to the centerline of the cylinder. A series of readings will determine the profile of the cylinder liner along a line. The metal loss can be computed from the differences between profiles measured before and after running.

The Bureau of Standards developed a method of measuring wear more directly than by change in diameter. A pyramid-shaped indentation is made with a diamond indenting tool. Since the depth of the indentation is a function of its length and the length can be measured with a special microscope, changes in the depth of the indentation – changes due to wear – can be calculated. Accuracy of ± 0.00002 in. on the diameter is claimed, with smaller amounts of wear being detectable.

One instrument on the market measures cylinder bores by the resistance to the flow of air in the clearance between the liner and a spindle which is inserted. The spindle may be rotated to obtain any desired angular position and inserted to various depths for axial positions. Precision ring gages must be used to adjust and calibrate the instrument. A high-amplification model is capable of accuracies of ± 0.000005 in.!

Some researchers have measured wear by analyzing used oil for iron content.

These are only a few of the methods.

Makes Vehicles Safer By Speeding

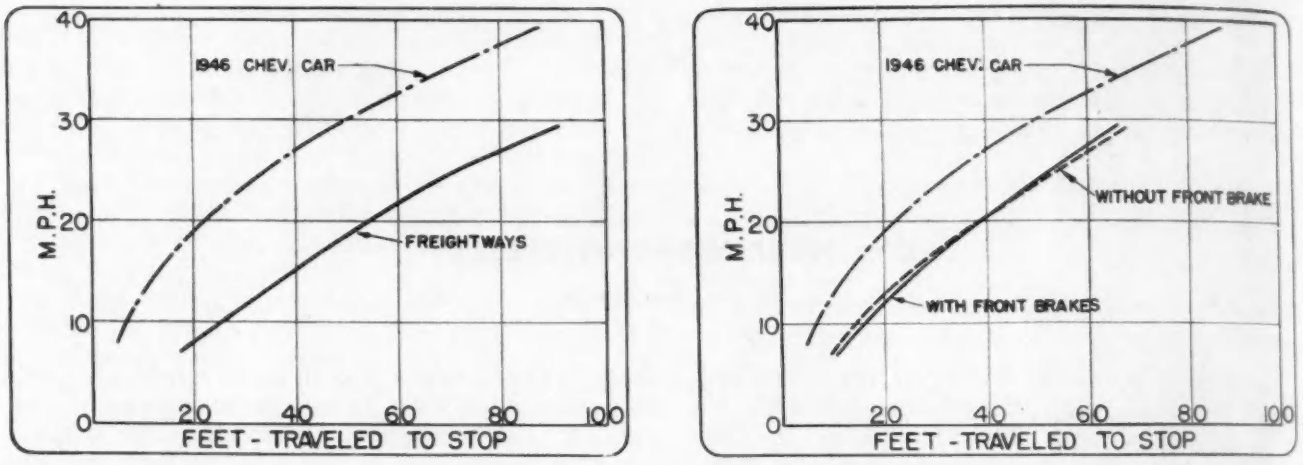


Fig. 1 – The curves at left show that a car will stop at 40 mph in less distance than the truck-trailer combination at 30 mph, despite the equal rate of deceleration. After modifying the truck-trailer's air-brake system for speedier braking, the truck compared more favorably with the car's stopping characteristics, as indicated by the curves at right

DESIGNING faster application and greater dependability into air brakes can improve safety of operation. Tests of modified systems showed the technical feasibility of overcoming many present air-brake objections.

Lag tests to determine the rapidity with which the system actuated the air brakes of three over-the-road tank truck-trailer combinations, each truck and trailer weighing 36,000 lb, disclosed the following:

1. Large brake chambers, front-wheel brakes, quick release valves, elbows, "T's," and other restrictions increase brake lag;

2. Lag is reduced by larger relay-emergency valves as well as by one relay-emergency valve for each pair of brake chambers;

3. Industrial air couplers, with a minimum of fittings on jumper hoses to trailer, will speed up trailer brakes;

4. A large, short-throw foot valve accelerates relay-valve action;

5. Slow or low air pressures to the brake chambers are danger signals that must be remedied.

Of particular interest in this work were tests with a 6-wheel truck and 6-wheel trailer combination. One relay valve supplied four brake chambers on the truck; another serviced two brake chambers on the front of the trailer; a third served four brake chambers on the rear of the trailer. The trailer brakes were slower than the truck brakes, but this could be corrected.

Fig. 1 illustrates the speeds and stopping distances of this truck-trailer combination compared with a passenger car. Although the deceleration rate of both were about the same, the car stopped in much shorter distances. The truck-trailer combination traveled too far because of the lag between brake-treadle depression and brake actuation.

At 20 mph the car stopped in 22 ft whereas the truck-trailer required 52 ft.

Speeding up the air-brake system through modifications closed the gap between stopping distances for the truck-trailer and the car. Again with equal deceleration rates, the curves at right in Fig. 1 show that 12 ft were pared from the 20-mph stopping distance. Turning off the front-wheel brakes bettered all stops below 20 mph and some for speeds as high as 32 mph.

Apparently the added lag from the front-wheel

*Paper "Air Brake Designing – to Reduce Failures and Speed Up Action," was presented at SAE Summer Meeting, French Lick, June 2, 1947. Paper "Brake Troubles Increased with Power Application," was presented at SAE National West Coast T & M Meeting, Los Angeles, Aug. 21, 1947. The former paper will be published in full in SAE Quarterly Transactions.

Air Brake Action

BASED ON PAPERS* BY
Julius Gaussoin
President, Silver Eagle Co.

brakes slowed down the entire brake system. But the jumper hose installation is far more important than front-wheel brakes on truck-trailer combinations.

Fig. 2 depicts some of the modifications that decreased stopping distances. The photograph at left shows one relay-emergency valve supplying only two brake chambers on the trailer. This installation has no elbows or restrictions between the air reservoir and valve and no fittings – other than the jumper hoses – between the valve and brake chambers.

The shut-off valves on the application line were installed for testing. They proved helpful in isolating part of the brake system when trouble occurred on the road and when mechanics checked the brake system.

This system is also reasonably free of extra fittings. No elbows are used at the brake chambers. Lateral "Y's" on each side of the valve improve air flow to the brake chambers. A fitting at the "T" feeds to the gage on the dash which indicates actual brake-chamber pressure.

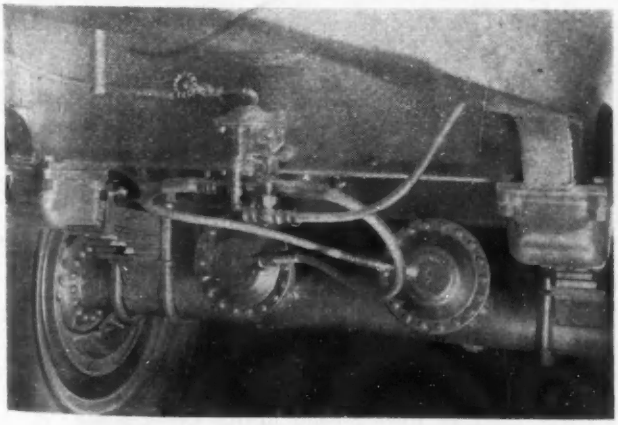
The industrial air couplers shown at the right in Fig. 2 speed up trailer-brake application and preclude the need for shut-off cocks. They open and close automatically when the driver attaches or detaches the jumper hoses, preventing wrongly-positioned shut-off cocks through driver error.

While these couplers leak less air, weigh less, cost less, and are virtually trouble-free, it is believed that air-brake parts manufacturers can produce an automatic trailer coupler better adapted to truck-trailer service.

Another attractive arrangement is a 6-wheel truck installation consisting of three air tanks. The front tank is a wet tank for condensing or filtering. The second, a pilot tank, serves the foot-brake valve and other accessories. The rear tank supplies cleaner and drier air to the truck brakes through a relay-emergency valve. This provides emergency brakes for the truck.

Check valves, automatic couplers, emergency valves, and an extra air tank reserved for brakes reduce failure from air loss in the brake system. They also minimize jumper hose, diaphragm, and valve troubles.

More careful attention by truck and trailer manufacturers to power brake factors such as those mentioned can change the oft-seen legend on the rear of commercial vehicles from DANGER – AIR BRAKES to SAFE – AIR BRAKES.



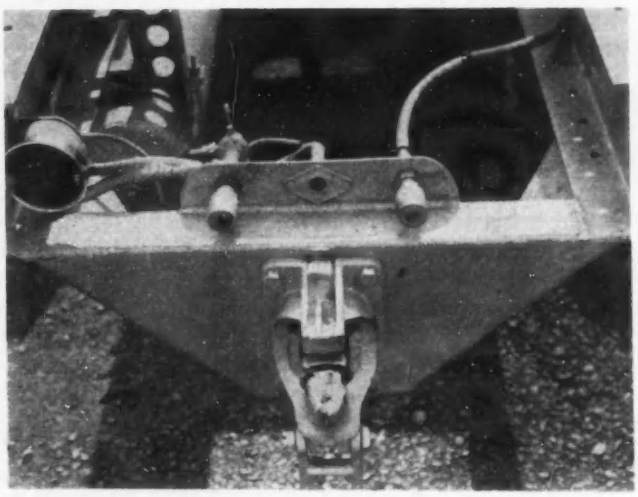


Fig. 2 – One factor which decreases air-brake lag is the use of one relay-emergency valve, as pictured at left. The automatic industrial air couplers in the right-hand photograph eliminate the possibility of the driver's leaving conventional shut-off cocks in the wrong position to invite an accident

BASED ON A PAPER* BY

R. G. Hilligoss, Manager, Bartlesville Bus Co

Cost of Bus

INITIAL cost of a bus is one of the smallest expenses of intra-city operation. Too much emphasis has been put on the competitive purchase price of vehicles, and too little upon the larger costs of operation and maintenance.

This conclusion is based on the results of 525,000 miles of operation in one city over a period of several months. These buses run 18 hr per day with an average mileage of 176 per bus. The engine is stopped once during the 18 hr and that is at the end of a 9 hr shift to check the oil level. The vehicles operated are 27 passenger rear engine buses. This fleet is typical of many.

Cost per mile was found to be:

Mechanical expense which includes all parts, shop labor, shop supplies and all material used in maintenance—2.07¢ per mile.

Gasoline and oil cost, 3.02¢ per mile.

Tire cost, 0.9¢ per mile.

The operating cost of the fleet including maintenance, gasoline, oil and tires was 6.17¢ per mile.

The general operating conditions have much to do with the maintenance and the mileage cost. Street conditions can, if neglected, cause the downfall of the best maintenance program. It is an important part of any public relations department to keep city officials in touch with street and road conditions upon which bus routes are maintained.

The attitude of the driver is another important phase of the general operating condition. It is of utmost importance that the relationship between the driver and the maintenance department be of the best. Without the careful, conscientious handling of equipment, it is impossible for the shop or maintenance department to make any maintenance program efficient.

This company requires each driver to spend a minimum of one week in the shop before going out on the route to breakin. This experience familiarizes drivers with the many problems of the shop and acquaints them with the working parts of the bus.

Road failures are very costly. They do more to break down public relations and to cause dissatisfaction among patrons than almost anything else that can happen in the bus business. The manufacturing industry has done much to improve the dependability of the city bus, but there is still much to be done in this respect.

The first major trouble began to appear when oil filler caps and dip stick began to show signs of varnish. One out of three units began to use oil after 10,000 miles and required rings at 20,000 miles or less. Heavy-Duty detergent oil was used from the start. The first step in determining the cause of engine varnish was to lower the viscosity of the oil from SAE 30 to SAE 20 in hopes of increasing the quantity of oil over hot spots. The

TEST 1

To pull varnish vapors out of the engine, a test was made by drilling and tapping the valve chamber cover, and drawing air from the chamber through a flexible tube into the intake side of an electric blower type fan. Test failed because varnish collected on fan's commutator and stopped it after about four hours of operation.

* Paper "Operation and Maintenance Problems in Intra-City Bus Transportation," was presented at SAE Mid-Continent Section, March 28, 1947.

Is Smallest Expense

gum content of the fuel was taken and no excess amounts were found.

No excessive operating temperatures were found, after careful checking. Normal running temperatures were 160 to 180 F, and the highest at a stop after a long grade, was 205 F.

To pull varnish vapors out of the engine five tests were made:

Drilling and tapping the valve cover and installing a pipe fitting for a flexible tube from the valve chamber to the intake side of a... lectric fan (using a blower type fan) resulted in a complete failure because the varnish collected on the commutator of the fan motor and stopped it from running after about 4 hr.

Exhaust Aspirator Unsuccessful

Then attempts were made to design an exhaust aspirator which would draw the varnish vapors from the engine. Several efforts were made but none were successful because of the lack of velocity of exhaust from the engine through the exhaust pipe.

More work was done with an electric fan – this time the use of an oil bath air cleaner on the breather of the engine and to fit a plate around the air filter using an electric fan to force the air through the filter and through the crankcase. The crankcase was then vented to obtain proper forced ventilation. Test was fairly successful because ring jobs were raised to 35,000 and 40,000 miles.

Another test, similar to the above was made. The life of the electric fan was increased by installing the oil bath air filter to the intake side of the fan.

The final test was made by securing a larger type blower fan designed so the varnish, when pulled through the inlet of the fan, could not get on the commutator. The buses are now running with forced ventilation. Ventilating the engines did not entirely eliminate all varnish but a decided improvement was made. In addition to ventilating the engine the additive in the oil was raised from 2½ to 3%.

The average mileage at this time between the ring jobs is 35,000 miles and the average life of an engine before reboring is 80,000 to 90,000 miles. There is still considerable work to be done both by the engine manufacturers and the lubricating people, although actual varnish deposits are less prevalent and the water emulsion type of sludge has never been present in this fleet.

There is still a very harmful type of carbonaceous deposit of a hard granulate substance in rather large quantities. This deposit is known to the shop as coffee grounds. It clogs oil rings and forms in valve chambers, around valve stems, valve guides and on oil pump screens.

Maintenance being carried out with this fleet is working well. Charts record mileage, gasoline and oil consumption, and repairs made and 1000, 5000, 10,000 and 20,000 mile inspections.

TEST 2

An attempt was made to design an exhaust aspirator to draw the varnish from the engine into the exhaust pipe. An oil bath air filter cleaned the intake air into the valve chamber. Lack of velocity of exhaust gases from the engine through the exhaust pipe caused this test to fail.

The 1000 mile inspections include checking the cooling system, engine, electrical and ignition systems, transmission and differential, wheels and brakes, steering, body and complete chassis lubrication.

The 5000 mile inspections include the 1000 mile inspection and in addition a compression test, setting of the governor to 2800 rpm, cleaning oil pump screens, adjustment of brakes, cleaning of the fuel pump and testing of distributor points. This also includes the setting of the clutch interlock which is a device used to prevent the slipping of the clutch by the action of shutting off the accelerator when the clutch pedal is down. Transmissions are checked for proper shifting.

At 10,000 miles the 1000 and 5000 mile inspections are repeated, the distributor is changed, generator bearings are packed, carburetor is cleaned and overhauled, differential and transmission are drained and refilled and front wheel bearings are repacked.

The 20,000 mile inspections include the 1000, 5000, and 10,000 mile inspections and flushing and refilling of the radiator. Also the oil consumption record is checked. If the engine is averaging 2 qt or more of oil per day, rings are installed or a complete engine overhaul is performed. Air compressors are overhauled at the same time. The 20,000 mile inspection also includes packing of rear wheel bearings and installation of brake diaphragms, inspection of brake drums and linings, adjustment of steering gear, adjustment of pinion backlash in the differential and the checking and refilling of shock absorbers.

Periodic inspections are recorded on the maintenance chart in different colors. Although this maintenance is all-inclusive, road failures continue to be greater than they should. Water pump failures are among the most difficult to predict, because some run as few as 50 miles and others 100,000 miles before failure. No accurate method has been found to determine an exchange or overhaul period for pumps.

Distributor failures are less prevalent because, since points are tested with a dwell meter, distributor failures continue to show up at 5000 mile tests. Most trouble is caused by points becoming too close and having excessive dwell.

Compressed air for brakes, windshield wipers, and door operation is a great improvement, but there are road failures due to oil pumping. Inditions are that air filters are generally inadequate.

Despite generator packing and new brushes every 10,000 miles, generator troubles give some road failures. Most are traced to generator bearing failures.

No maintenance program is complete without tire inspection. Examination is made for cuts, excessive wear, and pressure every 1000 miles in this fleet. Improved tread design is responsible for a total of 135,000 miles per carcass with three recapping jobs. Buses now run 30,000 on the original tread and 35,000 on each of the three recaps.

TEST 3

Again a blower electric fan was used. It was hooked up to blow air into the oil bath filter on the breather of the engine and force it through the crankcase, which was vented. Test was fairly successful because ring replacements were raised from 35,000 to 40,000 miles.

TEST 4

Here the oil bath air filter was mounted on the intake side of the electric blower, and forced through the valve chamber, the engine block and out of the pan through a vent. Life of the fan was increased, but test was not conclusive.

TEST 5

A larger blower, designed so as to prevent varnish deposits on the commutator, was connected to a vent in the crankcase pan, drawing air through the filter, valve chamber, engine, and out into the atmosphere. Decided improvement resulted.

LIGHT WEIGHT, SMALL SIZE Claimed for 2-Cycle Diesel Barrel Engine

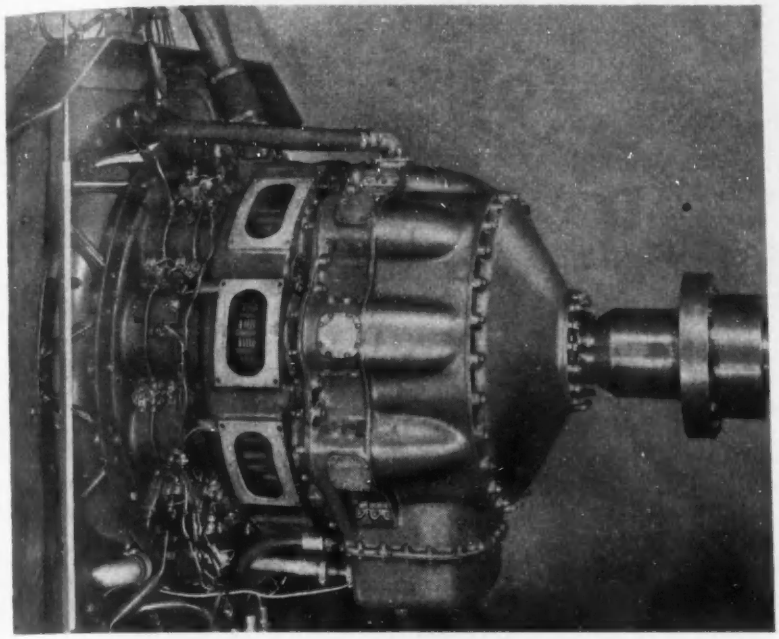


Fig. 1 – Front or exhaust end of slant aircraft engine

BASED ON A PAPER* BY

T. L. Sherman

Chief Engineer, Diesel-Engine Division, Steel Products Engineering Co.

THE barrel engine – so called because the cylinders are arranged like the shell chambers of a revolver – has been successfully applied to the opposed-piston type of 2-cycle diesel. (See Figs. 1 and 2.) Although this engine was originally designed for aircraft use it now seems more likely to have commercial and marine possibilities where light weight and small size are paramount considerations.

Performance

At 1200 rpm (the speed most likely for non-aircraft purposes), the rated output is 1000 bhp (2.3 lb per hp) with a bmep of 81 psi and a piston speed of 1600 fpm, although outputs as high as 1200 bhp have been obtained at this speed. So far the highest output on a steady, held operation has been 1600 bhp at 1800 rpm.

Fig. 3 shows a representative fuel consumption curve and also one obtained under odd conditions (the short curve). The clutches driving the blower impeller were found to be slipping about 25%. Speed and load conditions were absolutely steady and some of the consumption rates were taken from total fuel weight used over 20-min intervals. The measured quantity of air passing was only just equal to engine displacement at 1200 rpm, which is probably responsible for the rapid rise in fuel consumption over 60 psi bmep. In view of the low figures reached – less than 0.32 lb per bhp-hr – there was considerable checking of the test apparatus, but no discrepancies could be discovered. The scavenge pressure was only 2.5 in. of hg. The condition was evidently just an instance of what can be accomplished in 2-cycle engines when conditions are favorable. Efforts to duplicate these figures later by cutting down the blower impeller were not successful, but sufficient time was not available for a complete investigation.

The combustion efficiency of a diesel engine

* "Slant Mechanism – Its Fundamentals and Application to Diesels for Aircraft and Other Low-Weight Fields" was presented at the SAE Summer Meeting, French Lick, Ind., June 6, 1947.

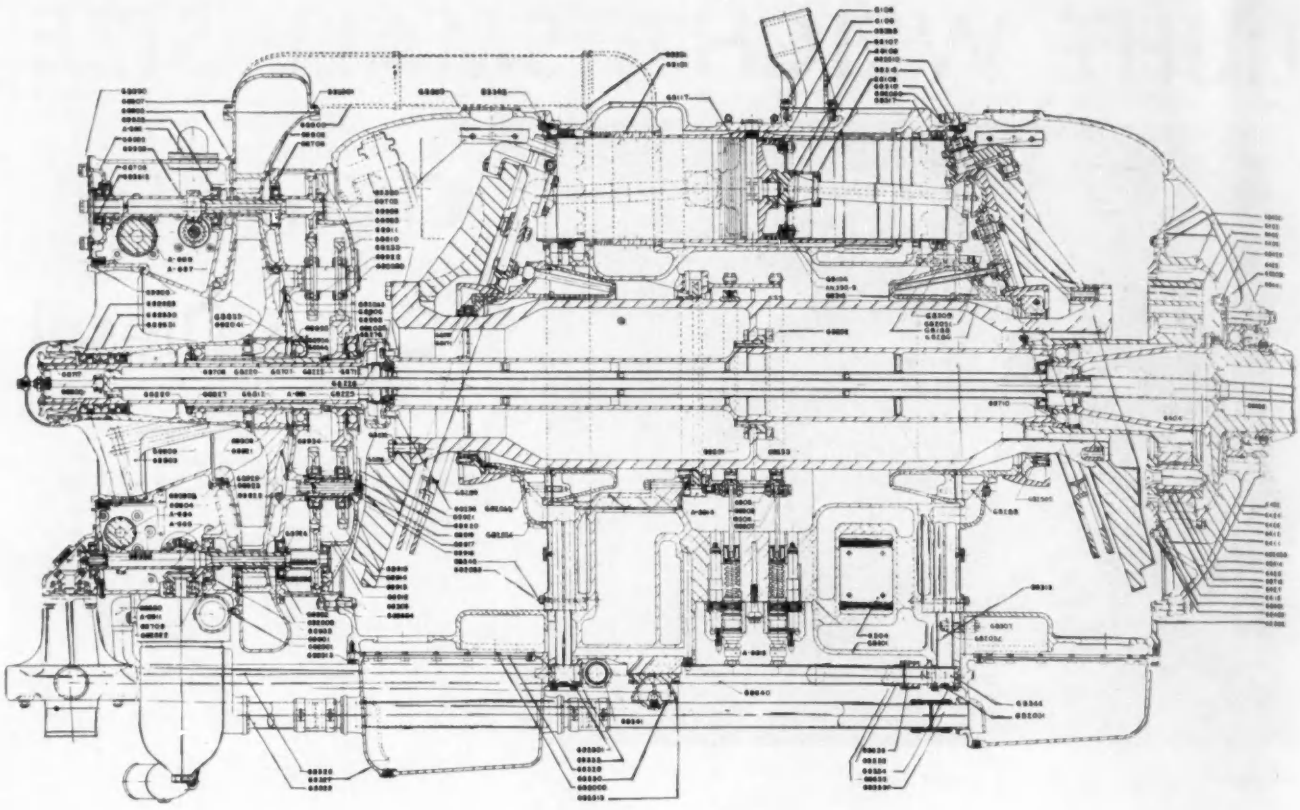


Fig. 2 – Longitudinal section of slant aircraft engine

remains constant under part loads, so that if horsepower output is plotted against fuel rate, the result is a straight line that, on being prolonged to strike the output ordinate for zero consumption, gives friction horsepower, as shown in Fig. 4. Thus, the friction horsepower at 1200 rpm is about 200, giving an overall mechanical efficiency of 83% for 1000-bhp output. The thermal efficiency of combustion of this particular test (full line) was not the best that the engine was capable of, but the straight-line characteristic was well held and the determination of friction thereby quite accurate. This 200-fhp figure was checked on several occasions and was found to be substantially accurate for engine oil temperatures around 200 F. The broken line is closer to normal performance and tends to show the same result. Tests run at 900 rpm show a mechanical efficiency of 90% for an output of 750 bhp. Blower and all accessories are included in the mechanical efficiencies.

Description

The powerplant is based on the crankless engine invented by A. G. M. Michell of Melbourne, Australia.[1]

[1] See SAE Transactions, Vol. 35, December, 1940, pp. 504-519: "More Power from Less Engine," by E. S. Hall.

The opposed-piston diesel engine was chosen for development because it seemed that the Michell-crankless mechanism is more suitable for this type of engine than the crankshaft system is. The new mechanism offers a simple shaft system devoid of gearing, shifts the major tension loading from the structure to the steel shaft, has no valve operating problems, offers better accessibility, and allows the engineer to design an engine that is compact and that has minimum overall dimensions.

The engine (Fig. 2) has nine equally spaced cylinders arranged parallel to the main shaft. These cylinders serve two opposed sets of nine pistons each. Two slant mechanisms are used to convert the reciprocating motion of the two sets of pistons to the rotating motion of the main shaft. The pistons are of 6-in. diameter and 8-in. stroke, giving a displacement of 4070 cu in. A diameter of only 43 in. will enclose both the engine and the accessories. Total overall length, including propeller shaft, is 90 in. Dry weight is 2340 lb, although further refinements in design could probably make a substantial reduction in this weight.

The basic construction of the engine consists of a central cylinder block, two slant cases, a reduction gear unit at the propeller end, and to the rear, an accessory housing containing drives and mountings for all standard aircraft-engine equipment,

including lubricating oil and coolant pumps. At the base of each slant case is a small oil sump. These are scavenged by separate units in the oil pump assembly.

Operation of Slant Mechanism

Fig. 5 shows diagrammatically how the slant mechanism works. The slant plate *a* is attached to the main shaft *b*, supported only by bearing *d*. The piston *e* is connected by a short, ball-ended rod *f* to a cage member *g* located on bearing *h* parallel to the inclined surface of the slant.

As the piston is driven back on the combustion stroke, the force is transferred through the rod *f* to the slant by means of the slipper pad, which slides on the slant *a* with an absolute minimum of friction. As the slant is rigidly fastened to the shaft, the only way it is free to move is in rotation. As it revolves (thus driving the main shaft) it changes its angle with respect to the cylinder centerline, thus allowing the piston to move outwardly from the combustion chamber.

The kernel of the slant mechanism is the pivoted slipper pad. On its reliability and efficiency depends the practicability of this form of construction. Theoretically, the functioning of an unsymmetrically pivoted slider is the most perfect fluid bearing known. It has superior shock resistance, load capacity, and high-speed characteristics, as compared with ball or roller types. It possesses inherent ability to adjust itself for optimum performance in applications where variations in load, surface speed, and viscosity of lubricant exist. Tests on full-scale slippers in a specially built testing machine show coefficients of friction of less than 0.001 for loads of the order of 2500 psi at a velocity of 250 fps. Under the average loading in the actual engine, it is estimated that a coefficient of 0.003 will not be exceeded. In the test machine the slippers operated at 2500 psi continuously for long periods without any sign of trouble, while in the engine this load lasts at most for 10 deg of rotation.

Cage Member

As first constructed the cage member was located radially on a journal bearing attached to the slant, as shown in Fig. 5, and the simple rotational control of a block sliding between flat plates attached to the bottom of the slant case was adopted. As a result, a resonant condition occurred at 1100-1200 rpm, which necessitated the following modifications.

The engine was fitted with torque reaction plates, each having a guide surface in the shape of a lemniscate because this curve is the locus of movement of the cage, as shown in Fig. 5. These plates act in conjunction with rollers mounted on the cage adjacent to each piston rod socket. These rollers are of hardened, 55-58 Rockwell C, SAE 52100 steel with electrolytic silver lining. The guide plates are of similar hardness and material.

The cage location bearing attached to the slant was also removed in favor of a fixed spherical mount, as shown in Fig. 2. This mount is now regarded as one of the most substantial detail developments and has done much to provide a practical, efficient construction. Its location of the cage is independent of shaft movements and it has a fixed, definite relation to the position of the torque guide plates. Under operating conditions the reactions parallel to the slant surface applied through the cage to the spherical surface of the mount do not involve relative motion between the parts, since there is merely a shift from point to point around the mount. The friction is therefore an absolute minimum.

As shown in Fig. 6, the cage is of builtup con-

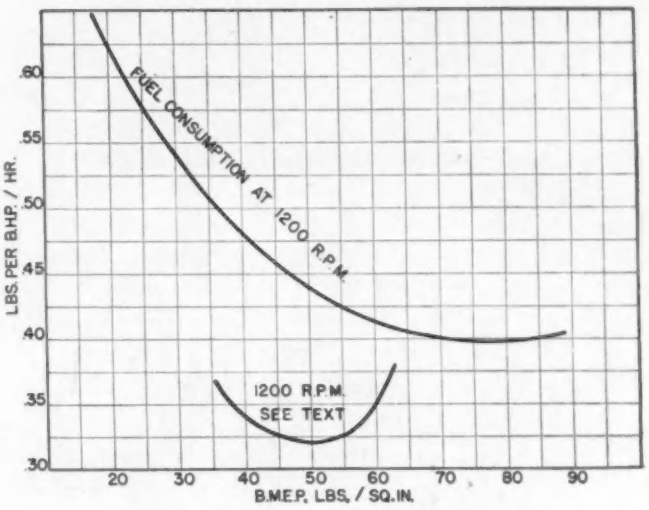


Fig. 3 (above) – Fuel consumption at 1200 rpm

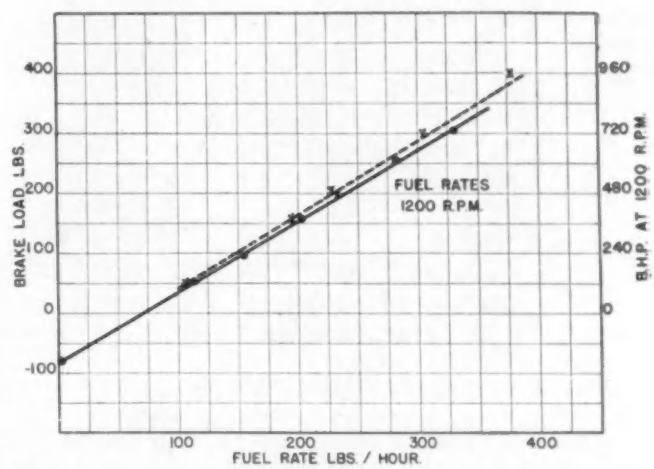


Fig. 4 – Fuel rate-output curve for determination of mechanical efficiency

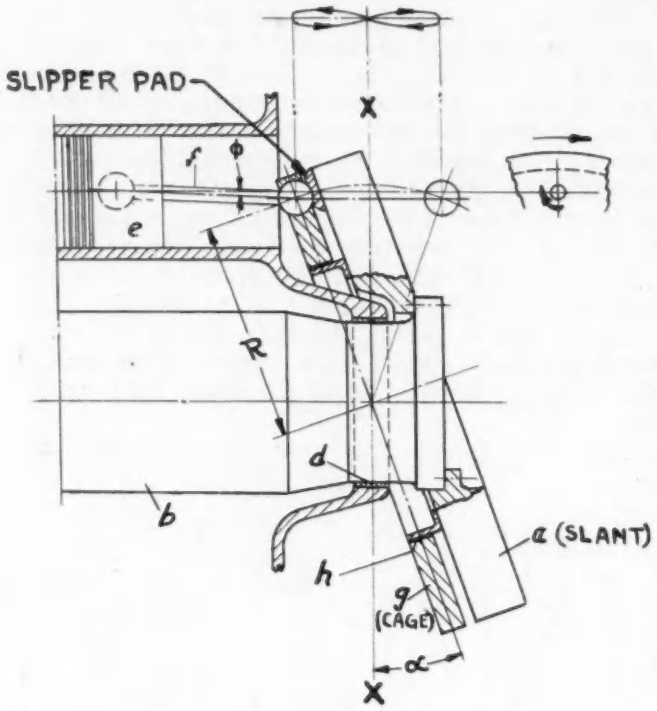


Fig. 5 (above) – Basic slant-cage mechanism

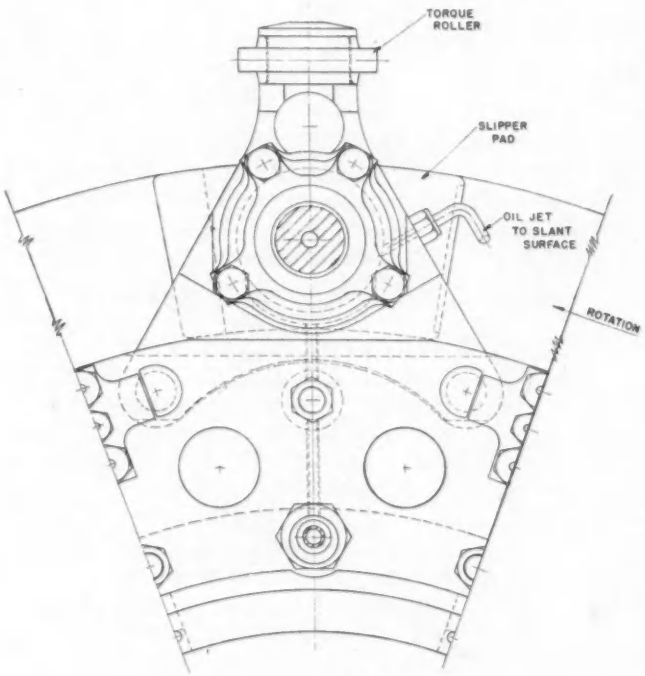


Fig. 6 – Part view of cage assembly

struction. At speeds over 1400 rpm the small circular slipper on the narrow track on the rear side of the slant (Fig. 2) comes into use for a short interval during the latter portion of the compression stroke. For commercial engines running at 1200 rpm, the only use for such a bridge member with small slipper is in starting.

Fig. 2 shows that the slant members are attached to the flanged ends of the main shaft in such a way that the piston loadings do not apply tension to the mounting bolts. In fact, the friction from the load applied between the abutting surfaces of the slant and the shaft flange is sufficient to carry the torque transmitted. These surfaces show no signs of relative movement or fretting.

Slant-Shaft Assembly

Fig. 7 is a photograph of the 570-lb slant-shaft assembly. Each slant weighs 175 lb and is made of SAE 4340, 36 Rockwell C steel, although another set made of SAE 4820 with gas carburized slipper tracks has stood up well.

The main shaft is mounted on two main bearings located close to the centers of oscillation of the cages. These bearings carry the lateral reaction arising from the slipper-slant coaction, which is close to 15,000 lb. The bearings are plain aluminum-alloy bushings, split and housed in the spherical mount for the cage.

Piston Assembly

The piston assembly consists of a forged steel head to which is bolted a comparatively long skirt, which runs in a fixed guide bushing and ring gland assembly at the mouth of each cylinder, although the more standard type of piston carrying its own scraping rings is now preferred.

Piston rings have always behaved satisfactorily and no rings have had to be replaced throughout the development. The cylinder barrels are nitrided and the rings are chrome plated. The piston skirt has a short, tinned bearing land immediately below the rings; otherwise the skirt runs free of the cylinder surface.

The piston rod is located at both ends in spherical joints. That at the piston has only a small oscillating movement caused by the angularity of the rod with respect to the cylinder axis. At the cage end the movement is much greater, as it involves the angle of dip of the slant. The continuity of the motion is favorable to good bearing action and the release of loading during the compression stroke enables the oil film to be replenished.

The cylinder barrels are separate nitralloy units mounted in an aluminum-alloy block. Sealing of the cooling passages and air chambers is effected by spring-like, U-shaped projections machined on the barrel, which provide a mechanical pressure joint under all conditions of differential thermal expansion between cylinder and block. The scavenge air porting consists of a number of rows of drilled holes with varying angles of presentation and the exhaust ports are of rectangular form. The bars between the latter are drilled for passage

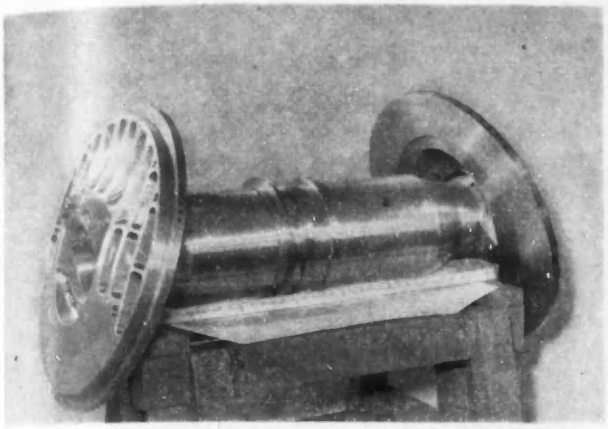


Fig. 7 – Slant-shaft assembly

of coolant. The external surface of the central combustion portion of the cylinder is machined to provide a number of channels for a similar purpose.

A centrifugal scavenging blower is mounted immediately behind the accessory drive gears and is driven at 6.5 engine shaft speed. The impeller is centrally located on the same axis as the main shaft of the engine and is surrounded by a diffuser. From this the air is taken through two part-circular ducts to the scavenge chamber in the cylinder block. The accessory gear-blower unit is an independent assembly and can be detached *in toto* from the end wall of the slant case.

Lubrication

Lubrication of the engine is effected by a gear-type oil pump that forms part of the pump-filter assembly located below the accessory mechanism at the rear of the engine. The oil is led by external tubing to two points at the base of the engine, where it is distributed throughout the engine.

Coolant is supplied by a centrifugal pump at the extreme lower rear of the engine. From here it is piped to the lower side of the annular cavity immediately in front of the scavenge air chamber. From this cavity there are nine parallel flows through the cylinders with equalization determined by the resistance provided by the high-velocity channels surrounding the combustion space and the drilled passages in the exhaust port bars. After passing through the latter, the coolant joins a complete annular system with return flow around the exhaust chambers with outlet either behind the exhaust system, as shown in Fig. 2, or by means of a manifold that could be used with a frontal radiator.

■ ■

WEST COAST T&M MEETING

continued from page 20

use of roller bearings instead of pins and bushings in several parts in the interest of low maintenance costs, rubber mounted springs and torsion bar suspension.

Another discusser added to the list improved wiring, body design and construction from the repair and maintenance point of view, better hardware and improved landing gears.

Public Relations and Legislation

Operators have thought too little about the effect of public opinion in the minds of the public on restrictive legislation, the meeting brought out. An unfriendly attitude was seen growing toward truck drivers on the part of motorists, which has a definite and measurable result in legislative enactments. To be free to meet the demands of increased business in the face of rising equipment and operating costs, operators must exchange antagonism for friendliness, it was suggested.

Expansion of cooperative highway patrols supported by fleet operators was urged. Driver training, beside being a factor in safety and economy of fleet operation, is an important element in developing this friendliness.

Pressure by fleet owners for larger vehicles was opposed because of the structural limitations of many highways and bridges.

Liberalization of length and weight regulations in several states was good news to most of the fleet operators who attended the meeting, when a speaker analyzed postwar state legislative changes.

The trend east of the Rocky Mountains has been similar, but Indiana remains a transit bottleneck with a 40-ft length limit for combinations. But on the point of dual axle equipment, the West Coast was said to be 20 years ahead of the east.

Analysis of California laws disclosed serious implications to the future of highway transport in that state.

Fleet Operation Is Important

EXCERPTS FROM A PAPER* BY

FREDERICK C. HORNER

Director, Field Operations Section, Distribution Staff, General Motors Corp.

HERE are a few things to which the fleet operator fails to pay proper attention:

Driver Training: Here, even a small investment would pay big dividends. Prof. Amos Neyhart of Pennsylvania State College, one of the pioneers in fleet driver training, recommends:

That an application blank covering sufficient details, be used, and a careful unhurried interview, verification of selected references, physical examinations, intelligence tests to check the mental characteristics of the applicant, personality inventory, a check on vocational interests, an attitude test, and traffic and driving knowledge tests including driver skill and psychology tests, besides the usual check on police and state drivers' records.

What Operators Say

Let me quote what one of the outstanding fleet operators of the country recently wrote me on this subject:

> "Fleet owners have failed to recognize the need for training the driver.
>
> "Today's highway outfit represents an investment of from $7,000 to $25,000, plus the value of the freight that frequently runs into thousands of dollars—sometimes in excess of a quarter of a million dollars.
>
> "Handing over this sizable investment in equipment to an inexperienced driver should be listed as a criminal offense. Every mile they are permitted to move over the highways, they endanger the life and limb of experienced highway users, or they destroy property running into thousands of dollars.
>
> "Who is to blame? Certainly not the driver. The responsibility rests with the fleet owner, or the executive in charge of highway operations. Drivers should not be entrusted with this modern equipment on the highways until they have made a minimum of thirty student trips and passed rigid driving tests, and established beyond a doubt a reasonable knowledge of the mechanical devices that are installed on the modern units to control the loaded vehicle under all conditions.
>
> "Eye tests and health checkups should be routine procedure at regular intervals. These highly specialized drivers should receive training designed to insure safe, efficient, economic handling of the expensive units on the highways. Their responsibility is comparable to that of the pilot of an airplane, and the time spent in training these men should be the equivalent of the education required by airship pilots.
>
> "Men responsible for fleet owner operations on the highway will do well to heed the warnings of the public to us. State highway officers, police officers and others are clamoring for better trained highway transportation drivers!
>
> "An aroused public will demand highway operating restrictions that will slow down fleet operations and interfere with normal earnings and eventually destroy motor truck transportation, or at least prevent its normal growth, if we fail to create a corps of motor truck transportation highway drivers that are recognized as specialists in their field.
>
> "The men to be given the responsibility of operating the modern tractor-trailer trains

* Paper "Fleet Operation Is Important Business," presented at the SAE National West Coast Transportation & Maintenance Meeting, Los Angeles, Aug. 21, 1947.

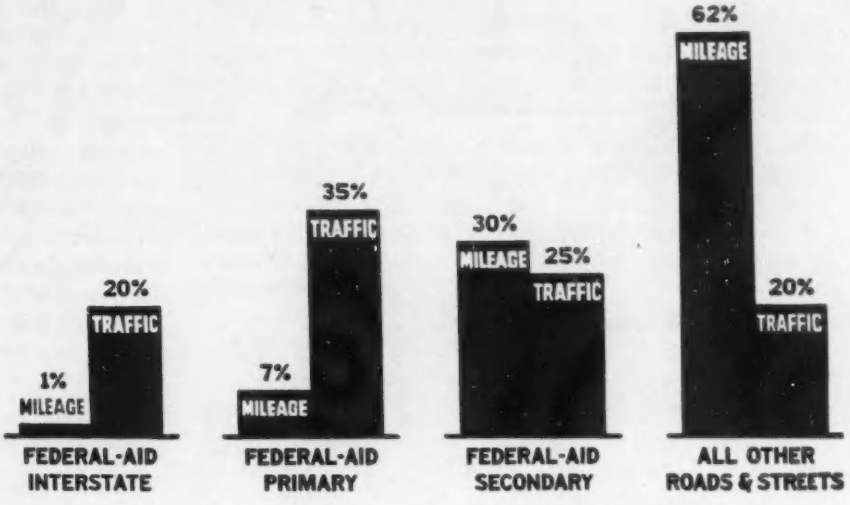


Fig. 1 – Future traffic by road systems

> will be dependable, experienced, safe, seasoned veterans who are familiar with all the rules and capable of meeting emergencies . . . drivers that will remain cool and collected in the face of danger, and such men will be supervised and directed by fleet owners with vision to see the future possibilities for expanded highway transportation that will incur the good will of the public, and the passenger car users of the highway, as well as the state police and highway officials.
>
> "Better trucks and tires, improved safety devices, modern highways are needed, but the most important of all is better drivers, trained specialists, well paid.
>
> "Physically fit, mentally alert, seasoned drivers are the answer."

Driver Attitude and Economy

The attitude of the driver and his driving habits will have an important bearing on the economy of the fleet's operation. Howard Willett, Jr., of the Willett Co., Chicago, operating 400 to 500 units, told me recently that since inaugurating a driver training system in their fleet, they had saved thousands of dollars per annum – both on insurance and in other economies in the general operation of the fleet.

Public Relations: In my travels, both while with the War Production Board and since, I had an opportunity to see how heavy duty over-the-road truck and bus equipment was being operated with special reference to the motorists' rights and privileges. On far too many occasions I was most unfavorably impressed.

Hogging the road was one of the most glaring and frequent offenses, not only on two-lane, but also on four-lane highways. On the latter the driver straddled the white line, thus blocking the motorist from passing.

Still another case of truck drivers not obeying the rules of the road is where on grades on two-lane, or even the dangerous three-lane roads, he blocks the motorist going up and races down at a speed that prohibits safe passing by the motorist.

The speed at which some of these big units travel on the West Coast just appalls me.

A big middlewest fleet operator told me that after the police put a 45 mph speed limit on one of the main highways in his area – *and* enforced it – within six months the accident rate in his and other fleets on that highway was reduced an average of 50%. At first he was dead against the police plan, but now he is 100% for it.

Aside from the safety angle and general abuse of the equipment, these things result in bad public relations for the over-the-road fleet operator.

Reasons for Recklessness

In my opinion, the main reasons why many of the fleet operator's drivers are so reckless and ignore the other fellow's rights are—

1. Lack of driver training, and
2. The "big boss" himself and his top men running the outfit fail to ride the highways both on the units and in their cars making on-the-spot observations. Two of the big operators in California have their own road patrols.

Here I want to urge the over-the-road fleet operator in particular and the commercial motor

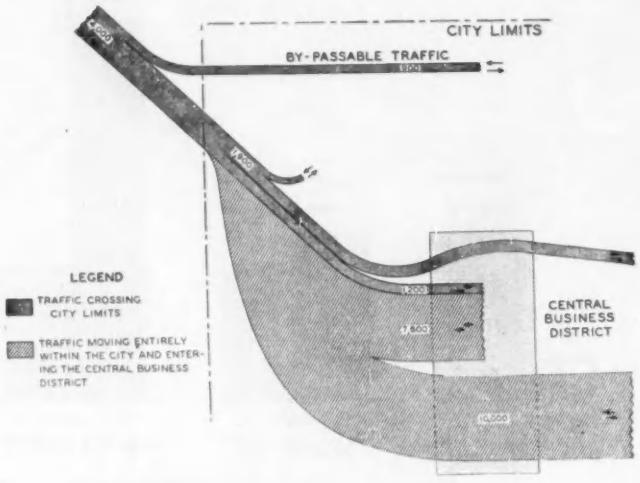

CITY LIMITS
BY-PASSABLE TRAFFIC
LEGEND
TRAFFIC CROSSING CITY LIMITS
TRAFFIC MOVING ENTIRELY WITHIN THE CITY AND ENTERING THE CENTRAL BUSINESS DISTRICT
CENTRAL BUSINESS DISTRICT

Fig. 2 – Origins and destinations of traffic on an interstate route through a typical city of 50,000-100,000 population, based on data from seven cities

vehicle and bus operator in general not to press for legislation permitting larger and longer vehicles than now permitted in your respective areas, before carefully analyzing the consequences in so far as the cost of building our highways so that such vehicles (1) can be operated with safety to all concerned, and (2) that these vehicles will not unduly damage the highways. This would result in increasing fuel taxes and fees in order to provide funds for the highway departments to meet the users' requirements, both from standpoints of safety and utility.

For the past ten years, a nation-wide highway planning survey has been carried out by the State Highway Departments of America, in a national program co-ordinated by the U.S. Public Roads Administration.

What Studies Show

These studies show that half of all miles of peacetime motor travel in America is on the 10% of our highway system we call "city streets." And that four out of every five vehicles on all rural roads are headed for a city or coming from one. And that traffic increases *only* near cities, and reaches a peak downtown about six times as high as at the city outskirts.

The chart shows the relation between traffic approaching the city and the volume which has crigins and destinations in the central business district, including that volume of traffic originating within the city. This chart is based on results from seven cities in the population group of 50,000 to 100,000, and shows that only about 20% of the approaching traffic can by-pass the city entirely; but of all traffic entering the downtown area, over half enters only to go through.

Half the traffic, in other words, that is in the most congested area of the city, is there because there is no way for it to avoid going through the district. This principle, if it is borne out by more complete data from subsequent analyses, is that routes approaching cities should not by-pass the entire area. They should approach the central business district but not go through it, following around the edge of the central business district by an inner circumferential road or streets as closely as possible to give through-traffic a short route to points beyond and to give convenient access to the downtown area for traffic with that as its destination.

Highway Program Good

Our highway officials have a magnificient post-war highway program just now getting under way. It recognizes fully the farmers' need for low-cost all-weather roads. It recognizes that our main rural highways are growing old and must be rebuilt to modern standards. It recognizes also that a very limited mileage of main routes leading into and through urban areas requires the express highway design, because of the huge daily traffic volumes involved.

We are on our way to a scientific classification of roads and streets on the basis of traffic needs, and to the application of practical design standards to give us the utmost in built-in safety and efficiency.

At the top will be less than 2% of our roads and streets that carry the highest daily traffic in America and that should exist for no other purpose but the movement of traffic.

Below that point, the practical compromises will start and will be justified by the drastic drop in traffic problems as we leave the top 2%.

All of us can help this new program get under way by taking an interest in our state and local highway planning, and supporting the new state-federal highway program that has been developed by engineers who have spent their lives trying to give us safe, better roads and streets.

Safety: We cannot neglect the importance of safety. Too often we are inclined to dismiss safety as a factor being promoted by the emotionalists who lose sight of practicalities in their enthusiasm for the humanitarian side of safety.

Efficiency and Safety Interlocked

Many operators are also inclined to accept a certain amount of traffic accidents as inevitable. But all operators in varying degrees strive for more efficient operation of their businesses. It must be recognized that efficiency and safety are inseparable, for we cannot have the one without the other.

Safety is a very profitable by-product of good facilities and operations, and so closely tied into economy of operations that to neglect it will mean

a constant drain on your resources.

The most important recent happening in our efforts to reduce highway accidents was the President's Highway Safety Conference held in Washington in May, 1946.

That meeting was the first Highway Safety Conference ever called by the president and was a result of Mr. Truman's grave concern over the tremendous up-swing in traffic accidents since the end of gasoline rationing. He said: "This trend has already taken a tremendous toll of our nation's resources in loss of lives, injuries, and property damage."

He also stated in speaking of Federal participation in traffic safety that the "main share of public responsibility rests with the state and local agencies," and significantly, he then added, "but we cannot expect the Congress and the Federal Government to stand idly by as the toll of disaster continues to go unchecked."

Back of the idea of the meeting was the conviction based on the recorded experiences of states, communities, and municipalities, such as yours here, that the "know how" existed for controlling and reducing traffic accidents to a minimum. However, that requires nation-wide teamwork, by every official having traffic safety responsibility, and by every citizen, and at every level.

Many other steps of importance took place during those three days in Washington. You are generally familiar with them, I am sure. However, I personally feel that the following statement made in the closing minutes of the Conference, highlighted the theme of the meeting and gave every delegate there an inspiring message and challenge to take back to the community he represented.

"With even a reasonable application of our new 'know how' and reasonably widespread organization in our states and communities, the national traffic death rate for 100 million miles can be brought down from 12 to 6 in three years," the minutes of the Conference said.

That was the challenge, prediction and goal placed before the delegates in the final session by Paul G. Hoffman, one of our nation's top industrial executives and one of the greatest leaders the highway safety movement has today.

We are still prone to leave safety to the "other fellow" and to direct our attention on the more pressing things – things which seem to effect more directly our daily lives. It is time that we took stock of what we have accomplished, of what is still to be done, and what can be done in the light of new experience.

That is why the three national committees established by last year's Conference strongly recommended to President Truman that the Action Program group be reconvened for the purpose of appraising progress and developing means of accelerating the national program. The meeting this year was held June 18 through 20, and President Truman wrote the governor of each state announcing the meeting and urging attendance and support.

Past experience of the larger fleet operators indicates that they do recognize the value of safety programs and safety training in their business. Accident experience of the larger operators has been improving and, as compared to individual operations, it is far superior.

Likewise, the response to assistance available through national programs, such as the Motor Vehicle Fleet Supervisors Training Course, is indicative of a desire to combat the accident problem at its source.

You, as operators, have a grave responsibility for safe performance of your vehicles and drivers on the streets and highways of this country – a responsibility that is highlighted by the fact that the public, especially the motorist, is all too ready to be critical of your operation.

Discussion of Wilson Paper

cont. from page 26

operation. The test was still in progress, so the powerplant had not been torn down for measurements and photographs.

The 228 cu in. bread truck engine was torn down when the 5568-mile test had been completed. The engine parts were clean, and operation had been satisfactory.

Landon Boyd and Cecil N. Bentley, DeLuxe Products Corp., reported 6642 miles in a company-owned Chevrolet. The ash content was less than the new oil, and on a rerun of 15,388 miles, ash content reached only 0.017. It was the personal opinion of the former that the LB-300 remained wet on the cylinder walls, giving better compatibility between the cylinders, pistons, and rings, thereby preventing contaminating blow-by from the combustion chamber.

Reporting a year's test on a fleet of 20 bakery trucks, C. J. McArdle, director of transportation, General Baking Co., found no trouble from sludging, discovered that the synthetic oil satisfactorily removed previously existing sludge deposits, cold starting was improved, and maintenance costs and oil economy with the synthetic were either comparable with or showed some improvement over the performance of the petroleum lubricants previously used.

A group of 12 laundry delivery trucks totaled 189,500 miles on a synthetic lubricant test, using LB-300. According to E. W. Schroll, fleet manager of Little Falls Laundry Co., dirty engines were being cleaned up during the runs, oil lines and screens were free, oil economy was generally better, and carbon and valve work had been reduced. These tests are being continued to determine engine overhaul life.

Jet Engine Charts Shortcut to Design

BASED ON PAPER

By IVAN H. DRIGGS

Navy Bureau of Aeronautics

(This paper will be published in full in SAE Quarterly Transactions)

THE Bureau of Aeronautics' Design Research Division developed a set of charts for estimating performance of simple-cycle turbojets and turboprops. The charts were devised to help the airplane designer determine quickly the performance characteristics of all the gas turbine powerplants he is considering for a particular airplane design.

They are based on experimental data covering the relationship between thrust, fuel flow, and airflow and on a thermo-dynamic analysis of the gas turbine cycle.

Key variables are nondimensionalized so that the charts—although drawn for static sea level conditions—may be applied to any combination of altitude and airspeed. (Paper "Preliminary Performance Analysis of Gas Turbine Powerplants," was presented at SAE Summer Meeting, French Lick, June 5, 1947.)

Two-Way Radio Grows Into High Frequencies

BASED ON PAPER

By C. F. MEYER

General Electric Co.

PRACTICABILITY and expanding use of mobile two-way radio forced the move to new high-frequency ranges. But operation in these new bands is not without its problems.

Since the theoretically-correct antenna length for a mobile transmitter operating on 1600 kc used in early two-way radio days is 154 ft, engineers went to the 30-42 mc region which only required a 7-ft antenna. Investigations showed that radio waves in this band traveled in a direct line of sight, with only a slight curvature at the earth's surface. Line-of-sight propagation also greatly reduced interference using amplitude modulation.

Single Band Crowded

As the 30-42 mc band became filled with stations, interference again became a serious problem. But rapid wartime advancement in design for higher frequencies made it possible to relieve this overcrowding by going to the 72-76, 152-156, and 952-960 mc bands.

While there has been little experience to date with the 72-76 mc range, skywave interference appears to be less at these frequencies than at 30 mc. And antennas only need be half the length—about 3 ft for cars. But the band has one drawback—it's sandwiched between two television channels. Television sets being inherently sensitive to interference, might bring numerous complaints from annoyed receiver owners.

Higher Frequencies Desirable

Radio engineers were pleasantly surprised to find the 152-162 mc band superior to the 32-42 mc range in covering built-up urban areas. The shorter wavelength signals seem to fill canyons between buildings, bridges and tunnels, eliminating many dead spots.

But the waves do not carry as far; 15 to 20 miles is about the best average range possible even with excellent station installations. And short waves will not bend around hills as well as longer ones.

The 952-962 mc band is principally for relay or repeater stations to rebroadcast a signal and for point-to-point work. Very little equipment is yet available for this band. Behaving almost like light, ultra-high-frequency waves are often directed to a point by a parabolic reflector. No attempt has been made to use this frequency for mobile radio because reception is impossible except within sight of the station antenna. (Paper "Mobile Radio," was presented at SAE Mohawk Hudson Group, Schenectady, May 20, 1947.)

Aluminum

Based on paper

By F. O. LEWIS

The Dayton Power & Light Co.

ALUMINUM truck bodies stretch the operating dollar further than steel construction in public utility fleet operation, despite the light alloy's higher initial cost.

To prove whether the lighter and more expensive material was warranted, several trucks with all-steel bodies were purchased in 1941—very similar to the aluminum-body equipment acquired a number of years before that time. The truck in Fig. 1 is one of the light-weight vehicles then already in operation.

Aluminum Cuts Weight

Table 1 compares the weights and costs of the two groups of 6000-lb capacity vehicles. Note that the change from aluminum to steel bodies added 2000 lb to the gross vehicle weight and increased vehicle weight 35%, an average of 2600 lb per unit.

While directly due to the heavier bodies, this weight increase did not stem from only the bodies. Larger rear axles and heavier springs raised chassis weight 10% – from an average of 5520 to 6080 lb. The 3864-lb all-steel body weighing 113% more than the 1808-lb aluminum construction made up most of the weight difference.

A factor which should be injected

Table 1 – Comparing Initial Cost and Weight of Aluminum Versus Steel-Bodied Public Utility Trucks

Truck No.	Year Built	G.V.W.	Vehicle Weight	Capacity lbs	Chassis Cost	Body Cost	Auxiliary Equip.*	Total Cost
All-Steel Bodies Based on 4.8 Years (Average) of Operation								
64	1941	16,000	9,750	6000	$1537.00	$1249.00	$1238.00	$4018.00
65	1941	16,000	9,830	6000	1537.00	1249.00	1211.00	3997.00
121	1941	16,000	10,050	6000	1537.00	1237.00	1062.00	3836.00
122	1941	16,000	10,050	6000	1537.00	1237.00	1082.00	3857.00
38	1941	16,000	10,040	6000	1537.00	1427.00	999.00	3965.00
Average	....	16,000	9,944	6000	1537.00	1260.00	1119.00	3934.00
All-Aluminum Bodies Based on 8.6 Years (Average) of Operation								
82	1936	14,000	7,240	6000	1162.00	1590.00	1029.00	3881.00
74	1936	14,000	7,230	6000	1163.00	1590.00	1180.00	3933.00
153	1937	14,000	7,390	6000	1278.00	1581.00	880.00	3739.00
155	1937	14,000	7,430	6000	1278.00	1681.00	735.00	3694.00
171	1937	14,000	7,480	6000	1345.00	1684.00	826.00	3855.00
5	1939	14,000	7,210	6000	1363.00	1698.00	691.00	3752.00
Average	....	14,000	7,328	6000	1265.00	1639.00	807.00	3811.00
Average Increase		2,000	2,616	....	272.00	.....	212.00	123.00
Average Decrease		.....	.....	....	.....	359.00	.....	.....
		14%	35%		21%	28%	23%	3%

* Includes winch, power take-off, derrick, winch line, water cask, oil filter, nigger head, caboscope, paint and labor to paint vehicle and install equipment.

Truck Bodies Trim Operational Costs

in the initial cost picture is the influence of rising labor and material costs on all items. The auxiliary equipment, for example, is shown to cost more because of both a general price rise and the addition of one or two items not included in the older group.

Cost of Dead Weight

From an operating standpoint the additional 2600 lb of dead weight will cost at the same rate as payload. And since much of the work these trucks do is in off-the-road operation, the difference in total weight can easily mean the difference between pulling through or being mired down.

Table 2 compares the tire and fuel mileage for the two groups of vehicles. While not a large item of cost, tire wear was increased 15% by the additional 2600 lb of vehicle weight. Fuel consumption suffered less than 0.25 mpg with the steel construction. But some allowance should be made here since the steel body units are relatively new and have the advantage of the two-speed rear axle. Other factors being equal, this weight differential would up the fuel bill about 5%.

Savings in license fees over the life of the vehicle alone more than offset the increase in cost of aluminum over steel. The 35% weight increase boosted the license charge from $100 for the aluminum body jobs to $155 for the trucks with steel construction.

Fig. 1 – This is one of a group of aluminum-bodied public utility trucks that the Dayton Power & Electric Co. found more economical to operate than similar vehicles of all-steel construction

Aluminum body maintenance has been confined largely to damage by traffic accidents and through mishandling of heavy material such as transformers and poles. The metal is tough and will not crack or corrode. In paint shop operation, time for cleaning and refinishing an aluminum body averages 42½ hr as against 56 hr for the steel construction.

It has never been found necessary to paint the inside of aluminum bodies, whereas steel construction rusts from the inside and is always a problem.

While a change in accounting system made impossible comparison on a total cost-per-mile basis, little doubt remains that aluminum bodies have an edge over steel construction for this particular type of operation. (Paper "Light Weight Bodies of Aluminum for Trucks," was presented at SAE National Transportation & Maintenance Meeting, Chicago, Oct. 17, 1946.)

Table 2 – Comparing Fuel and Tire Economy of Aluminum Versus Steel-Bodied Public Utility Trucks

Truck No.	Year Built	Mileage 12-31-45	Tire** Mileage	Fuel Used 12-31-45	Fuel Mpg	Total Cost	Total Cost per Mile
All-Steel Bodies Based on 4.8 Years (Average) of Operation							
64	1941	47,615	32,708	6763	7.0	*	.116
65	1941	49,739	32,646	6870	7.2	*	.116
121	1941	24,787	***30,133	4280	5.8	*	.116
122	1941	32,835	***36,187	5057	6.5	*	.116
38	1941	24,633	***30,742	4063	6.0	*	.116
Average		35,921	32,488	....	6.63		.116
All-Aluminum Bodies Based on 8.6 Years (Average) of Operation							
82	1936	79,323	40,016	12,223	6.5	*	.116
74	1936	94,490	38,111	14,062	6.7	*	.116
153	1937	62,074	39,559	10,492	5.9	*	.116
155	1937	115,704	35,534	17,476	6.6	*	.116
171	1937	83,874	38,003	11,303	7.7	*	.116
5	1939	62,601	*	6,960	9.0	*	.116
Average	....	82,876	38,244	.....	6.85	*	.116
Average Increase	.....		5,761	.....	.22		....
			15%	.....	3%		

* Not available.
** Average of original tread on a total of 30 tires for each group.
*** Tire mileage estimated.

Modern Oils Impede Engine Wear & Tear

DIGEST OF PAPER

By C. E. TILSTON

Imperial Oil, Ltd.

TODAY'S motor oils possess engine-preserving characteristics that combat any type of operational punishment.

Good viscosity indexes prevent heat from thinning out, and cold from bodying up, the oil. Pour-ability affords proper engine protection for cold weather operation.

Threatening damage from extreme temperatures and heavy loads in heavy-duty operation is circumvented by inhibitors against oxidation and bearing corrosion. Detergents maintain

freedom from engine varnish and sludge by keeping in suspension any products of combustion in the oil.

Lubricants will do these jobs effectively if vehicle operators observe proper oil change periods. Supplying clean oil is a small price to pay for the protection it gives the original vehicle investment.

Most complaints levelled at motor oils are found unjustified after analysis of the trouble. Real offenders causing common headaches such as varnish and sludge are fuels and engine design. Indifferent maintenance also invites costly troubles. (Paper "Automotive Lubrication," was presented at SAE British Columbia Group, Vancouver, May 15, 1947.)

Stainless Steel Units Boost Fleet Revenue

BASED ON PAPER

By V. M. DREW

Fruehauf Trailer Co.

STAINLESS steel bodies will net economy-minded fleet operators a greater dollar return from their hauling equipment.

Increased revenue-producing payload and minimization of maintenance and upkeep more than offset stainless steel's higher initial cost.

Earnings Enhanced

For example, use of stainless steel members will lighten a conventional 28-ft semitrailer 1000 to 1500 lb. Such higher-earning units are in evidence on the roads today by the thousands. The other way of utilizing this weight saving is to increase body cubage at no increase in vehicle weight.

Another of the metal's merits is that it requires no protective coating. Stainless steel trailers and bodies in constant service during the last five to ten years reveal a remarkable permanence.

The material strongly resists operational damage and localizes impact forces. It's not unusual to see a stainless steel unit wrecked almost beyond recognition in only a small area, with the rest of the unit fully intact.

Damaged parts are easily removed and replaced. Chiseling between welding joints or using a light power hand saw followed by welding of the overlapped replacement will do the trick. (Paper "Light Steel Body Construction," was presented at SAE So. Calif. Section, Los Angeles, April 24, 1947.)

Airlines to Smooth Passenger Handling

DIGEST OF PAPER

By RODNEY W. KING

American Airlines, Inc.

GREATEST area for improving airline operation lies in handling the passenger—from the moment he requests a reservation to the time he boards the plane. New procedures and even machines are being tried both to minimize annoyance to customers and to prevent revenue losses inevitable with inefficient systems.

Flexibility of seat space distribution in all cities receiving demands for reservations on any given flight is most important in providing an economical and efficient reservations system.

Reservations-Selling Musts

Consider for example, a flight operating from New York to Buffalo to Detroit to Chicago. These and other cities will want to sell transportation on this trip in any combinations of space. The ideal system will satisfy these five standards:

1. All reservations handled on a first-come first-served basis, regardless of the city where they originate.

2. Reservations confirmed when the customer makes his request, saving him any follow-up and the airline the expense of such additional contacts.

3. Eliminating the possibility of turning away business because seat availability cannot be determined.

4. When reservations are not immediately available, provides waiting list procedure assuring accommodation of customers in order of their requests.

5. Brings in the highest possible revenue at the lowest possible cost.

Adequate communications is the key to such system. Teletype was tried for relaying information on a "sell and record" basis; but it broke down. City-to-city telephone lines offer some improvement using special talking procedures that cut message time to 20 sec. But the problem will again manifest itself when maximum capacity is reached on these lines.

A machine called the "Reservisor" tells the selling agent the situation for any space on any flight within the next 16 days. Recently perfected, it is now in use experimentally at American Airlines' Boston offices.

Still a time-consuming chore for both customer and agent, ticket selling should be simplified by an electronic ticketing machine now under development.

And delivering both customer and his baggage to the right plane at the same time is simpler than it sounds. Much information must be obtained about the passenger and his baggage without subjecting him to annoying interrogation.

Only with more experience and added facilities will the airlines make air travel more profitable to themselves and more agreeable for the customer. (Paper "Some Technical Aspects of Passenger Handling," was presented at SAE Summer Meeting, French Lick, June 5, 1947.)

Ties Life of Parts To Painting Method

Based on paper

By ROY B. DAVIS

E. I. du Pont de Nemours and Co.

PAINT best protects bus and truck parts only if properly applied to adequately cleaned metal surfaces. Film thickness, drying, and metal cleanliness can make or break a paint job.

While film thickness selection depends on the product and its use, a mil of both undercoat and topcoat is the generally accepted minimum. Thicker films – particularly of synthetic topcoats – produce a longer-life finish.

But if excessively heavy, the primer offers a poor holdout for the topcoat, results in little moisture-resistance, and tends toward brittleness after aging; enamels soften and wrinkle; lacquer chips and cold-cracks.

Best performance also hinges on adequate drying schedules. Underbaked films are soft and lack moisture-resistance and adhesion. Overbaking lessens topcoat adhesion, discoloring enamel and killing its gloss.

Cleaning the Metal

Surface treatment before painting varies from simple degreasing to phosphate coating, depending upon conditions of vehicle exposure. Poorly-cleaned metals deprive the finish of adhesion and blister-resistance. Unless the undercoat is designed for use over bare steel, only a treatment such as Bonderite will prevent severe blistering and loss of adhesion.

Achieving good results with reactive metals such as aluminum and zinc alloys requires some treatment to passivate them. Otherwise corrosion and premature paint-coat failure are as certain as death and taxation. (Paper "Organic Finishes for Increasing the Life of Bus and Truck Parts," was presented at SAE Transportation Meeting, Chicago, April 16, 1947.)

Ride Comfort Elusive Car Design Goal

Digest of paper

By ROBERT SCHILLING
General Motors Corp

(This paper will be published in full in SAE Quarterly Transactions)

DESIGNING riding comfort into cars is a compromise at best because eliminating one evil only aggravates others. Cut-and-try methods of weeding out frame-body resonances and controlling chassis shakes is the slow, but only sure, way to better ride.

For example, wheelhop – caused by hitting a road bump – induces vertical accelerations. While a number of solutions to this problem suggest themselves, none is a cure-all.

Reducing the unsprung mass will not better the ride in all respects as is generally supposed. It decreases shake acceleration. The shock absorber almost exclusively damps this motion since the tire provides little damping. Increasing shock absorber damping would reduce secondary motion amplitude and quickly kill it; but this also boosts forces fed into the chassis during the first stroke. Result: less shake, greater harshness.

Introducing damping in the tire might be a step forward. But 'how to do it' is not yet known. Incorporating a harmonic balancer in the unsprung mass is another way of introducing damping. However, both the added 20 lb per wheel and expense are still considered too high a price for the added riding comfort.

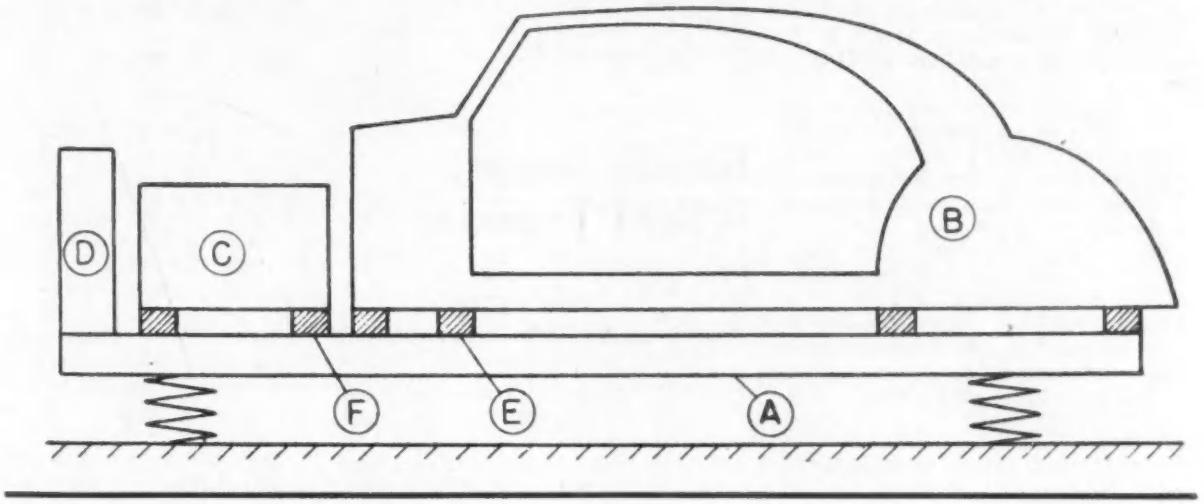
Suspension shakes further complicate the picture. Into this category fall parallel hop, fore-and-aft shift, lateral shift, yaw tramp, and windup. Some of these motions still defy agreed-upon mathematical analysis.

The sprung mass, responsible for structural shakes, is an elastic system with inertia distributed as in Fig. 1. Wheelhop and suspension shake resonances closely approach structural resonances of the sprung mass and excite them. When this happens car occupants complain of shakes in the body, cowl, or seat.

Stiffening the frame, bracing the body structure, or changing the engine mounting are all attempts to eliminate these shakes. But such measures nearly always increase harshness and noise transmission from the road. So back again to the trial-and-error merry-go-round of engineering a better-riding car. (Paper "Effects of Unsprung Mass on Ride," was presented at SAE Metropolitan Section, Feb. 20, 1947.)

Fig. 1 – One suspension engineering problem is keeping resonance of the sprung-mass elastic system – shown here – from producing annoying body shakes

A – Frame
B – Body
C – Powerplant
D – Front End Mass
E – Elastic Body Mountings
F – Elastic Engine Mountings



but increases harshness. Conversely, a larger unsprung mass feels less harsh, but more shaky.

Less stiff tires would appear to be a real improvement. They cut down wheelhop frequency and also increase damping effectiveness. Harshness and shake improve. But softer tires are a mixed blessing.

Greater radial flexibility means more lateral flexibility and poorer steering control. So until engineers can change the ratio between lateral and radial stiffness, soft tires are out as ride improvers.

A change in damping is the third way to minimize unsprung mass motion – the major cause of wheelhop ac-

States Raise Limits On Truck Length, Load

Digest of paper

By E. O. SAWYER, JR.
"Western Motor Transport"

MANY states have recently liberalized their regulations on maximum permissible length and gross weight of motor transports. Up-to-date information on the responsibility of weather – rather than load – for road wear indicates that state regulations could be revised still further to permit much greater loads, without causing undue

wear on roads.

This year's greatest gain in permissible overall lengths was made in New Mexico. Legal lengths for a single truck or bus have been increased from 40 to 50 ft and for combinations of vehicles from 60 to 65 ft. Wyoming raised the legal length limit on tractor-semitrailer units from 50 to 60 ft. Oregon upped the limits for combinations of vehicles to lengths of 60 ft and loads of 72,500 lb.

In the East, both Vermont and Maine raised load limits up to 50,000 lb gross from the previous 40,000-lb limit.

For years, legal codes have limited gross weight for the reason that lawmakers believed that heavy loads wore out their roads. Now, competent authorities on roads report that just plain water, applied at the right place long enough or often enough, is far more destructive than heavy loads.

In fact, Prof. J. S. Worley, of the University of Michigan, says that modern highways will safely carry about twice the loads presently permitted – that a 60-ft, 9-axle combination of 3-axle tractor, 3-axle rear-end assembly semitrailer, and 3-axle full trailer will easily transport 152,000 lb gross weight, allowing 18,000 lb for each dual-wheel axle and 8000 lb for the front axle.

Of course, bridges are the bottleneck which would prevent use of such loads—even if legislators allowed them. Bridges are usually constructed to carry traffic with single loads not to exceed 72,000 lb.

Sawyer predicts that sound transportation economics will eventually dictate gross loads of 150,000 lb as standard practice. Such loads are already required for transporting electric transformers, petroleum refinery towers, and mobile guns. (Paper "Regulations, Their Effect on Transportation Management," presented at SAE National West Coast Transportation and Maintenance Meeting, on Aug. 22, 1947.

Modern Maintenance Backs L. A. Bus Fleet

Digest of paper

By CONE T. BASS

Los Angeles Transit Lines

KEEPING Los Angeles Transit Lines' coaches on the road justifies owning and operating a radio station, using chassis dynamometers, and building specialized test equipment.

Roving supervisors in two-way-radio-equipped cars report bus breakdowns to a dispatcher. He in turn relays the message to the nearest maintenance division which sends out a service truck to make adjustments or repairs. If this will delay the schedule more than 5 min, a substitute coach is dispatched and the defective coach brought to the shop.

Each of five maintenance shops is equipped with a chassis dynamometer for major inspections. This method supersedes the former one of depending on a mechanic's road check to determine the vehicle's condition.

Road failures in this business are expensive; dynamometer detection of performance defects helps keep them to a minimum.

Much of the tool equipment used is designed and built in the shops. For example, a test stand which could not be purchased was built for making major engine inspections and tune-ups. Two engine dynamometers plus a number of instruments were hooked together in a sound-proofed room.

Each rebuilt engine is run on this test stand – diesels 3 hr and gasoline engines 7 hr.

Care and rapid repair are important ingredients in a 625-coach operation valued at $15,000 per coach. (Paper, "Modern Bus Operating and Maintenance Methods as Applied by Los Angeles Transit Lines," was presented at SAE So. California Section, Los Angeles, June 5, 1947.)

European Transport Is Slowly Recovering

BASED ON PAPER

By H. H. KELLY

European Central Inland Transport Organization

THREE significant factors stand out in Europe's current highway transportation picture:

1. Transportation has kept pace with slowly recovering production despite early fears that it would deter restoration.

2. United States is participating in Europe's restoration program by: (a) its military occupation of portions of Germany and Austria; (b) lending money and supplying materials and equipment for rehabilitation, and (c) cooperating in numerous international organizations.

3. Trend toward socialization of major industries will influence the long-term future of transportation.

Total European motor vehicle registration dropped from 9,000,000 in 1939 to only 2,400,000 in 1945 at the end of the war. Reconditioning and emergence of vehicles from hiding is said to account for the phenomenal rise to an estimated 6,600,000 vehicles at the beginning of 1947. And surprisingly enough, there seem to be more trucks (or vehicles operating as trucks) in Czechoslovakia, France, Greece, Norway, Poland, Sweden, Switzerland, and the USSR than there were in 1938.

But gasoline shortages, war-destroyed highways, and obstacles imposed by national boundaries hamper long-distance operations.

Attempts have been made to break down national barriers by the European Central Inland Transport Organization – recognized by the United States, Britain, and the USSR. It has brought the problems of coordination to its 13 member governments.

There is a strong move toward cooperation in the field of transportation despite the current political and economic strife in Europe. If there ever is a United States of Europe, steady pressure for interchange of goods and people will be a contributing factor. (Paper "European Road Transportation," was presented at SAE Washington Section, May 13, 1947.)

Postwar Fire Engines Meet Fireman's Needs

BASED ON PAPER

By A. G. SHEPPARD

American-LaFrance-Foamite Corp.

A SURVEY of fire chiefs and firemen all over the country resulted in newly-designed fire engines that are shorter, lighter, more maneuverable and provide better visibility.

The engine is now located behind the driver's seat for several reasons.

First, the driver sits out in front so that lack of visibility is no problem. Second, packaging the engine and pump in one compartment shoots a blast of hot air across the pump so that it cannot freeze in cold weather. Third, cab-ahead-of-engine design permits a reduction of wheelbase length from 180 to 150 in. This makes the new job much more maneuverable in congested traffic.

Powering fire equipment are 12-cyl "V" engines ranging from 170 to 240 hp. High horsepower engines are required to give high road performance. After getting to the fire, the engine drives a pump delivering as much as 2500 gpm at 120 psi. Modern pumpers can throw water under 500-psi pressure 1100 ft straight up.

Among the other new fire-fighting aids are a compact four-wheel truck carrying a 100-ft aerial ladder and foam and fog-throwing crash trucks. (Paper "The Development of Modern Motorized Fire Fighting Equipment," was presented at SAE Williamsport Group, Sept. 8, 1947.)

TECHNICAL COMMITTEE PROGRESS

Aero Groups Grooming Prop Shaft Standards

Standards for a complete line of propeller shaft ends for all aircraft engines now under development by three SAE aeronautic committees are looked to as a vital economy-making link between the propeller and engine industries. Committees P-6 and E-21 are jointly preparing standards for large sizes in both single and dual rotation types and Committee E-29 is concentrating on low-horsepower engine sizes.

This work promises to be an important contribution to the aeronautic field because the propeller shaft is basic in both engine and propeller design. Such inclusive standardization assures the engine builder that a propeller is available for the standard shaft he selects, eliminating the need for costly and time-consuming coordination with propeller manufacturers. And the same holds true for the propeller maker.

Additionally, these standards will simplify service, sales, and replacement in the field.

Important from both a military and civil aviation standpoint is the fact that the British are favorably inclined toward accepting the SAE standards – when issued – for the No. 60 and larger single and dual rotation shafts. It is felt that any international standards adopted should go through the No. 40 and 50 sizes as well. Only British objection here is to the straight-side splines; they favor involute splines.

Proposals for the large sizes of what is to be the first complete set of industry-made standards include:

1. AS 41B—Propeller Shaft Ends, Single Rota-

SAE TECHNICAL BOARD

A. T. Colwell, Chairman

W. G. Ainsley	William Littlewood
B. B. Bachman	R. H. McCarroll
W. J. Blanchard	Elmer McCormick
L. Ray Buckendale	G. A. Page, Jr.
R. E. Cole	C. R. Paton
J. M. Crawford	D. G. Roos
W. P. Eddy, Jr.	C. G. A. Rosen
J. H. Hunt	A. W. Scarratt
R. M. Insley	Mac Short
R. D. Kelly	T. C. Smith
G. W. Laurie	V. C. Young

J. C. Zeder

tion – size No. 7½, 10, 20, 30, 40, and 50 in straight splines and Nos. 60, 60A, 70, and 80 in involute splines.

2. AS 91A – Propeller Shaft Ends, Dual Rotation (Propeller Supplied Bearings) – for size Nos. 40-60 and 50-70 with straight splines on smaller or outer shafts and involute splines on larger or inner shafts. The 60-80 and 60L-80 combinations are for involute splines on both shafts.

3. ARP 375 – Propeller Shaft Ends, Dual Rotation (Propeller Supplied Bearings) – size Nos. 41-60, 51-70, 70-90, 70L-90, 80-100, and 80L-100.

4. ARP 374 – Propeller Shaft Ends, Single Rotation – for size No. 50A with straight spline and Nos. 41, 51, 51A, 90, and 100 with involute splines.

Virtual agreement has been reached on dimensional requirements for these standards. Only bottleneck to processing them for final approvals is a controversy between propeller and engine members of the Committees over a note on oil seal requirements. The engine group maintains that oil seal restrictions should cover only the flow of oil from the engine and should not require, as the propeller conferees feel it must, that engine seals retain oil in the propeller.

This dispute is being referred to the SAE Engine and Propeller Subdivisions for a final decision.

Conflicting stands had also been taken on the scope of these standards. The engine camp favored omission of standards for those sizes already covered by Government documents. Propeller Committee members' opinion that SAE standards cover all shaft sizes regardless of existing specifications was upheld by the SAE Aeronautic Committee.

Both Committee E-21 Chairman G. N. Cole, Pratt & Whitney Aircraft, and Committee P-6 Chairman R. P. Lambeck, Hamilton Standard Propellers, see early approval for these standards once such minor obstacles are cleared.

Head Prop Shaft Standardization

G. N. Cole

Chairman, SAE Aircraft Engine Components and Accessories Steering Committee

R. P. Lambeck

Chairman, SAE Propeller Standards Committee

Herb Rawdon

Chairman, SAE Small Engines Propeller Shafts Committee

Small Engine Shafts

Standards being prepared by Committee E-29 include those for wood-propeller hub and attaching parts for taper-type shafts, additional flange-type sizes, and complete revision of standards prepared by its wartime predecessor – Committee E-15 – to reflect present industry practice. Also under way is a recommended practice on propeller shaft ratings.

Better understanding of the scope and value of this work emerges from a flashback of this standardization area's history.

Origin of Work

Committee E-15 was created in the early war days at the request of the military services to standardize propeller-shaft ends for low-horsepower engines. Its objective was not to standardize on any one shaft, but to provide for interchangeability of the three types of shafts then current – flanged, tapered, and splined.

During its brief life – from April to September, 1942 – Committee E-15 prepared the following Aeronautical Standards which became an integral part of the light aircraft war program:

1. AS 126 – Propeller Shaft End – Taper Type – No. 0;
2. AS 127 – Propeller Shaft End – Flange Type – Nos. 1, 2, and 3;
3. AS 128 – Propeller Hub – Flanged – Spline Type – No. 7½;
4. AS 129 – Propeller Hub – Flanged – Spline Type – No. 10.

At the end of the war, personal plane, propeller, and engine manufacturers began urging shaft end standards patterned after commercial requirements rather than military needs. Swift compliance with this request was initiated by the SAE Aeronautics Committee by reviving the Small Engine Propeller Shafts Committee under the chairmanship of Herb Rawdon, Beech Aircraft Corp.

Initial assignment of this group was to explore the possibility of standardizing one type of propeller shaft end. But propeller designs already under way at that time rendered the plan impractical.

After considering all aspects of the three types, a majority of the Committee favored the flange type because it's cheaper to manufacture, weighs less, and makes for easier removal. As a result, it was agreed to designate the flange-type shaft "preferred" and the No. 0 taper shaft and Nos. 10 and 20 spline shafts "optional."

Flange Type Advantages

The Committee hopes this will gradually guide all design toward the flange-type shaft end. Adoption of only one type shaft would be a blessing to engine and propeller manufacturer by both simplifying manufacture and reducing costs. Stocking problems throughout the country's maintenance facilities would be relieved; only one instead of three types of propeller shaft ends would be in use.

Old standard revisions now in process will result in the following changes:

- AS 126 – brought up-to-date and issued as AS 126A with propeller and nose clearances added to allow for adjustable and controllable pitch propeller mechanisms;
- AS 127 – revised as above and issued as AS 127A with the No. 2 size made obsolete for new design and the No. 4 size added;
- AS 128 – cancelled since the No. 7½ size has never been used commercially.

The Committee is also developing the following four new standards for the taper-type shaft attachments:

a. AS 357 – Hub, Wood Propeller, Taper Type – No. 0;
b. AS 358 – Flange, Propeller Hub, Taper Type – No. 0;
c. AS 359 – Nut, Propeller Hub, Taper Type – No. 0;
d. AS 360 – Snap Ring, Propeller Hub, Taper Type – No. 0.

Shafts To Be Rated

Desire to help the designer select the proper shaft size motivated the Committee to prepare tentative ARP 373 on propeller shaft ratings. The rating factor is arrived at by multiplying engine torque (in ft-lb at engine rating) by the cylinder bore in inches. Based on this expression, the following ranges are being considered for direct drive:

- Use flange type – No. 1 . . . . for factor up to 1000,
- Use flange type – No. 3 . . . . for factor of 1000 to 1900,
- Use flange type – No. 4 . . . . for factor of 1900 to 2700,
- Use taper type – No. 0 . . . . for factor up to 1000,
- Use spline type – No. 10 . . . . for factor up to 1600,
- Use spline type – No. 20 . . . . for factor of 1600 to 4400.

How this factor is applied in practice is illustrated by the following example: Given a 150-hp engine rated at 2500 rpm with a cylinder bore of 4.375 in., the "torque x bore" factor equals $\frac{150 \times 33{,}000}{2500 \times 2^*} \times 4.375 = 1378$. Therefore, a No. 3 size flange type or a No. 10 spline type shaft can be selected.

SAE Committee A-5 Meets in Cleveland

Aircraft wheel and brake standards for use by the CAA headed the agenda at the Committee's last meeting. Members shown are (l. to r.) J. B. Schirra, Capital Airlines; H. L. Wagner, U. S. Rubber Co.; R. C. Cornell, Litemetal Diecast, Inc.; C. H. Kitchell, Bellanca Aircraft Corp.; R. E. Kibele, Curtiss-Wright Corp.; A. Braun, Civil Aeronautics Administration; J. D. Redding, SAE Staff; J. C. Battaglia, Civil Aeronautics Administration; F. D. Swan, Goodyear Aircraft Corp.; E. D. Monroe, Air Materiel Command; R. T. Keller, B. F. Goodrich Co., and Chairman W. H. DuBois, Bendix Products Division, Bendix Aviation Corp. Not present were H. H. Kerr, U. S. Rubber; B. H. Shinn, Firestone Aircraft Co., and E. R. Cunningham, Capital Airlines

Aim Wheel Specs At CAA Program

NEWLY-LAID plans of SAE Committee A-5 to develop minimum performance specifications for aircraft wheels and brakes extend the Society's participation in industry's contribution to the Civil Aeronautic Administration Technical Standard Order program.

The Aircraft Industries Association request to the SAE Wheels, Brakes and Axles Committee stems from CAA and AIA desire to replace pertinent portions of Civil Air Regulation with a Technical Standard Order based on the SAE minimum performance requirements. CAA representatives pointed out to Committee members that the TSO, when issued, will not be retroactive. The present Type Certificate for existing designs will be continued until conversion of all approvals to the new system becomes necessary.

The Committee is also directing its efforts toward development of quality standards for aluminum and magnesium die-cast wheels to curb excessive rejection rates of parts fabricated by this method.

High-pressure die-casting produces surface irregularities which, to the untrained inspector, necessitate scrapping the wheel. Yet numerous tests of such rejected wheels prove that such minor flaws do not impair performance or life, showing the high scrap rate to be unwarranted.

It was agreed to draw up a standard or recommended practice outlining inspection control that will not penalize serviceable wheels, including as much pictorial material as possible.

Chairman W. H. Dubois, Bendix Products Division, Bendix Aviation Corp., announced that E. R. Cunningham, Capital Airlines, and R. E. Kibele, Curtiss-Wright Corp., accepted invitations to serve on Committee A-5.

Group Seeks Gage For Vehicle Noise

SAE's Motor Truck and Motorcoach Committee has organized the Automotive Traffic Noise Subcommittee to comply with the Automobile Manufacturers Association's request that some means of measuring vehicle noise be found to guide legislative and law-enforcing authorities.

Concern of some western states over noise created by trucks passing on the highway makes it advisable to set up noise measurement on a sound technical basis. According to Subcommittee Chairman F. B. Lautzenhiser, International Harvester Co., his group will not attempt to define a tolerable noise level which is considered a responsibility of regulating authorities.

He outlined the Subcommittee's scope as follows:

1. To determine a suitable procedure for measurement of noise created by automotive vehicles;
2. To specify the equipment necessary to obtain comparable results;
3. To make traffic noise tests at specified points in representative parts of the country;
4. To provide statistical data on the noise level created by new vehicles.

From preliminary tests conducted by the group at the General Motors Proving Grounds, it appears that initial survey tests will have to include data in two frequency bands – (1) total noise on a 70-decibel weighting and (2) using a 600-cycle high-pass filter; both bands will be recorded simultaneously. It was also found advisable to take measurements at 50 ft from the center of the highway lane since at 25 ft, the difference in measured noise between the same vehicle on the inner and outer lanes is too great.

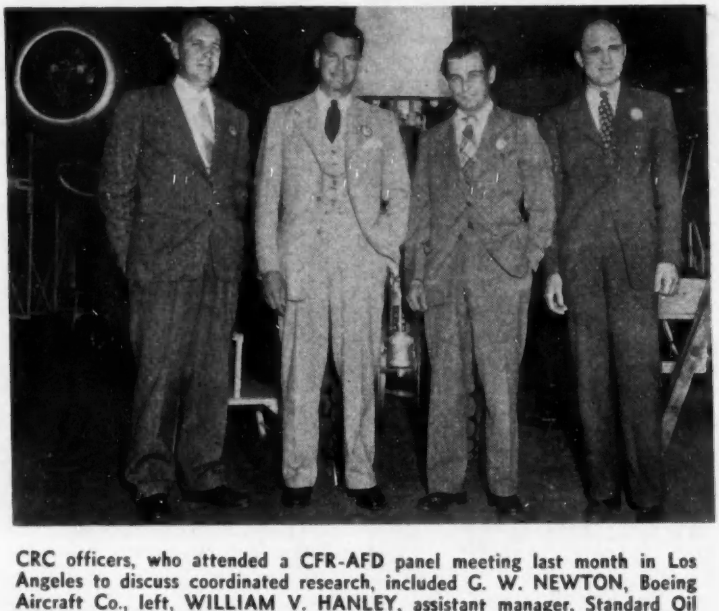
About two-thirds of the test results at the GM Proving Grounds were taken on recording equipment.

Another item the group is trying to resolve is the relationship between sound level and pitch.

As part of its job, the Subcommittee will conduct tests on a heavily-traveled mid-western road and on one in the New York-Philadelphia area. After completion of these tests it will be determined if greater samplings are necessary.

Serving with Chairman Lautzenhiser on the Subcommittee are: E. J. Abbott, Physicists Research Co.; D. C. Apps, General Motors Proving Ground; R. E. Brumbach, Mack Mfg. Corp.; B. B. Cary, Hayes Industries, Inc.; Paul Huber, Willys-Overland Motors, Inc.; A. H. Inglis, Bell Telephone Laboratories; G. F. Roddewig, GMC Truck & Coach Division; R. C. Norrie, Kenworth Motor Truck Corp.; E. S. Ross, Peterbilt Motors Co., and J. L. S. Snead, Jr., Consolidated Freightways, Inc.

CRC MEN IN CALIFORNIA



CRC officers, who attended a CFR-AFD panel meeting last month in Los Angeles to discuss coordinated research, included G. W. NEWTON, Boeing Aircraft Co., left, WILLIAM V. HANLEY, assistant manager, Standard Oil Co. (Calif.), M. K. McLEOD, manager of CRC, and ANDREW L. POMEROY, Ranger Aircraft Engine Division, and chairman of CFR Aviation Fuels Division. The group is standing in front of the new Boeing Strato-Cruiser, scheduled for this year's operation

About

Now employed as a design engineer in the Rotary Wing Division of Parsons Industries, Inc., Traverse City, Mich., **HARRY S. EGERTON** had been an instructor at the Academy of Aeronautics, LaGuardia Field, New York.

ALFRED MARCHEV, who had been president and chairman of the Board at Republic Aviation Corp., Farmingdale, L. I., N. Y., has been elected president and general manager of the Aircraft Screw Products Co., Inc. of Long Island City, N. Y.

JOHN G. PERRIN has recently retired from active work at Pratt & Whitney Aircraft, East Hartford, Conn. He was formerly chairman of SAE Committee E-8, Drafting Room Practice. He had served as an active member and adviser to Committee S-1, SAE Aeronautical Drafting Manual Committee, and also served on Committees E-26 and E-27. Perrin joined the Society in 1905 and was first vice-president of SAE in 1913.

E. A. PETERSEN, a past vice-president of the Society, has been appointed executive assistant to President **C. J. REESE** of Continental Motors Corp., Muskegon, Mich. He had been assistant chief engineer of the Tractor Division of the Massey-Harris Co., Racine, Wis.

The Institute of the Aeronautical Sciences and the British Royal Aeronautical Society held a joint meeting in London, Sept. 3-6. Forty American engineers, aircraft manufacturers, and executives attended this conference in which many mutual manufacturing and engineering problems were discussed. SAE members who attended included: **REX B. BEISEL,** United Aircraft; Assistant Secretary of Commerce **W. A. M. BURDEN, R. R. DEXTER,** I. A. S.; **WILLIAM ENYART,** president, Simmonds Aerocessories, Inc.; **SHERMAN M. FAIRCHILD,** president of Fairchild & Associates; **R. M. HAZEN,** Allison Division, GMC; **J. IDE,** U. S. Naval Reserve; **R. P. KROON,** Westinghouse Mfg. Co., **GROVER LOENING,** I. A. S.; **FRANK N. PIASECKI,** president, Piasecki Helicopter Corp.; **IGOR SIKORSKY,** United Aircraft; **THEODORE P. WRIGHT,** administrator, CAA; and **RAYMOND W. YOUNG,** vice-president of Wright Aeronautical Corp.

Having relinquished his position as instructor at the Air University, Maxwell Field, Ala., **SPEERS G. PONDER** is chief of the technical branch, Air Chemical Office, Aberdeen, Md.

The promotions of **F. W. KATELEY** to chief engineer and **E. G. MATHAUER** to assistant chief engineer of the ACF-Brill Motors Co. was recently announced. Kateley was formerly chief engineer of the Product Engineering Department, and had been associated with the ACF-Brill organization since 1926. Mathauer joined the company in 1924. During the past year, he was resident ACF-Brill Engineer at the Consolidated Vultee plant in Nashville.

GEORGE P. PAJARES, previously field service representative for Continental Motors Corp., Detroit, has become associated with the Falls City Flying Service in Louisville, Ky.

MAURICE R. ROBERTS has become owner of the Driggs Machine Shop in Driggs, Idaho. They will repair automotive and farm machines and manufacture some farm machinery.

Members

HOWARD W. CHRISTENSON was recently appointed development engineer, working on the commercial transmission program, of Allison Division, General Motors Corp., Indianapolis, Ind. He was recently transferred to Allison from the Detroit Transmission Division, where he was senior project engineer and assistant superintendent of the experimental laboratory. Christenson joined General Motors in 1937.

CLARENCE T. FISHLEIGH, who had been associated with his late brother Walter T. for 16 years as consulting engineer, has organized the firm of Clarence T. Fishleigh & Associates, 18074 Ohio Avenue, Detroit. He is a specialist in patent experting, investigations and reports, and preparing charts and models for litigation purposes. A graduate electrical engineer, he later won his degree of doctor of jurisprudence. Prior to 1930 he headed his own company in Chicago.

FRANK J. ROEHRENBECK, JR. is now employed as a junior mechanical engineer for the Monsanto Chemical Co. in Oak Ridge, Tenn.

The Atomic Energy Commission recently announced the appointment of four key men to atomic posts. SAE member among these men was **JOHN C. FRANKLIN,** of Kansas City, formerly vice-president of Trans World Air Line, Inc., to be manager of the Oak Ridge Office of Directed Operations.

No longer an applications engineer with Greer Hydraulics, Inc., in Brooklyn, N. Y., **JACK JEROME** is owner of the Jerome Hydraulics Co., Little Neck, N. Y. He was on the Membership Committee of the Southern California Section in 1944.

Recently resigning from North Carolina State College in Raleigh, **WOLFGANG E. MEYER** is now with the Engineering Experiment Station of Pennsylvania State College as associate professor in Engineering Research.

Preceding his appointment as assistant professor of English at Massachusetts Institute of Technology, Cambridge, **JOSEPH N. ULMAN, JR.** was associated with the Ethyl Corp. Research Laboratories in Detroit. He is going to teach courses in technical report writing.

EARLE W. WEBB, who had been president of the Ethyl Corp. for 22 years, has become chairman of the board. He had been associated with Ethyl Corp. since its inception.

GEORGE D. PENCE was recently elected president of the Wilson Foundry & Machine Co. in Pontiac, Mich. Prior to this post, he was assistant to the president at Willys-Overland Motors, Inc., Toledo, Ohio. Pence graduated from the United States Military Academy at West Point in 1924 and served in the U. S. Army until 1945, when he retired as a major general.

WALLACE O. LEONARD has been appointed assistant to the president of the Pacific Airmotive Corp., Burbank, Calif. He had been president and general manager of the Wilson Foundry & Machine Co., Pontiac, Mich. He had held that post since 1938.

C. S. McCANN has resigned as director of research for the Walker Co., Racine, Wis., to accept the position of chief engineer of the Treen Engineering Co., New Orleans, La. While living in Dayton, Ohio, he held the offices successively in the SAE Dayton Section then known as the Southern Ohio Section, of secretary, vice-chairman, and chairman of the Program Committee. In 1934-35, he was chairman of that section.

EARLE W. PUGHE, until recently connected with General Motors Corp., has become assistant to the executive vice-president of the Dana Corp., Toledo, Ohio. He had been affiliated with General Motors for more than 21 years. Pughe joined the SAE in 1926.

H. E. SCHWEGMAN is now an engineer with the Halliburton Oil Well Cementing Co. in Duncan, Okla.

Formerly connected with the National Pressure Cooker Co., Ltd. in Wallaceburg, Ontario, Canada, **HAROLD W. CLOUD** has become vice-president of Glenvale Products Corp. in Detroit. He will continue to serve as a director of the National Pressure Cooker Co., Ltd.

A. BRUCE BOEHM has been named manager of Paramins Sales of the Enjay Co., Inc., New York City, an affiliate of the Standard Oil Co. of N. J., and **IRVING E. LIGHTBOWN** has been named manager of Rubber Sales at Enjay. Boehm had been assistant manager of Paramins Sales. He has been an employee of the Standard Oil Co. of New Jersey or its affiliates since 1921. Lightbown had been assistant manager of Rubber Sales since 1942.

SAE Fathers and Sons . . . . .

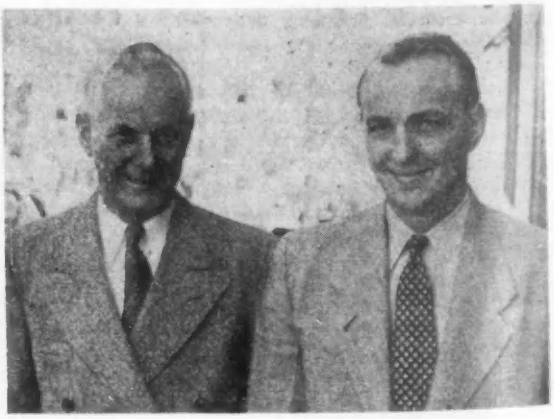
OLIVER H. CLARK, left, who recently retired as executive engineer for the Chrysler Corp. Engineering Division, with his two sons, **BRUCE E.,** center, and **H. DEAN,** right. Bruce is project engineer, Ford Chassis Engineering Division, Ford Motor Co., Dearborn, and H. Dean is an assistant, directing die styling at the Central Engineering Division of Chrysler Corp. The father joined SAE in 1922.

H. J. LAFAYE, assistant sales manager for the Rim Division of Goodyear Tire & Rubber Co., Akron, Ohio with his son, **HILTON J. LAFAYE, JR.** The son is senior designer (aircraft) for the Goodyear Aircraft Corp.

If any SAE reader knows of any SAE Father-and-Son combination, both of whom are members of the Society, your editors would appreciate hearing from you. Several SAE members have two Member-Sons.

We will write for photographs. Informal pictures of such combinations are preferred to individual formal portraits.

Your cooperation will be deeply appreciated – we don't want to miss any SAE Father and Son grouping.



A past chairman of the Oregon Section for 1945-1946, **WILLIAM NUNNENKAMP** is pictured with his son, **WILLIAM, JR.,** who is an industrial salesman for the Texas Co. in Portland. Ore. His father is service manager for Fields Motor Co. in that city.

HENRY FORD II, president of the Ford Motor Co., will be the speaker at the annual meeting of the Automotive & Aviation Parts Manufacturers, Inc., to be held Monday, Sept. 29, in Cleveland. **FRANK RISING,** general manager of the parts makers' association, said it will be the first time the annual meeting has been held outside Detroit.

Heretofore connected with Kelly-Squiers, Inc. – Consultants in Detroit, **THOMAS N. KELLY** is now with Continental Aviation & Engineering Corp., same city.

WILLIAM C. LEINGANG has become plant manager of the Electric Storage Battery Co. in Chicago. Previous to that post, he was with the above company in Philadelphia.

Previously affiliated with the Oslo Street Railways in Oslo, Norway as chief engineer, **EINAR ISDAHL** is now managing director of A/S Industrimateriell in Oslo.

JOHN LEROY PALMER is now special project engineer for the Lubrizol Corp. in Cleveland. Prior to this he was in the Central Engineering Division of Chrysler Corp., Detroit.

JULES BRAUNSTEIN is now a stress analyst at the Piasecki Helicopter Corp. in Morton, Pa.

Recently resigning as chief test engineer, Aircraft Gas Turbine Division, De Laval Steam Turbine Co., Trenton, N. J. **HENRY L. KOHLER** has assumed the duties of associate professor of aeronautics, Naval Postgraduate School, Annapolis, Md.

No longer a mechanical engineer at the Aircraft Engine Research Laboratory, Cleveland Airport, Cleveland, Ohio, **JAMES A. HILGENDORF** has accepted a similar position with the John Deere Tractor Co. in Waterloo, Iowa.

THOMAS L. KETTLES is now employed as a design engineer for the Automatic Switch Co. in New York City.

No longer a refinery superintendent for Refining Associates, Inc., Los Angeles, **HAROLD W. AGER, JR.,** is owner of the Ager & Davis Refining Co. in Portland.

Prior to becoming group leader of mechanical systems design at the General Electric Co., Schenectady, N. Y., **GORDON K. STEBBINS** was a design engineer for this company.

Before becoming owner of Penrod's Auto Service in Columbus, Ohio, **ROY C. PENROD** was service manager for Oestreicher, Inc., same city.

F. M. FALGE has been made manager of the General Electric Lamp Department's Pacific Sales District. Last June he had been promoted to the position of assistant manager. He joined General Electric as a lighting sales engineer for the Lamp Department at Nela Park in 1926, then joined Paramount Publix Corp. for three years and then returned to Nela Park. During the war, he was in the U. S. Navy.

ROBERT A. WEINHARDT, veteran automotive engineer, has joined Willys-Overland Motors, Inc. as automotive powerplant engineer. He will be in charge of all Willys-Overland engine design, including a new 6-cyl engine which the company is planning to produce. Prior to joining Willys-Overland, he was a chassis engineer for Kaiser-Frazer Corp.

WESLEY A. HARPER is now chief engineer for the National Farm Machinery Cooperative Corp. in Bellevue, Ohio. New quarters for the Engineering Department, which is being centralized under his direction, are being constructed there. Harper graduated from Ohio State University in 1925 and was employed by the Caterpillar Tractor Co. for 18 years. He started that company's proving grounds in 1936.

GEORGE K. DREHER has accepted the position of executive director of the Foundry Education Foundation, Cleveland. This is an incorporated organization, for the purpose of raising funds to provide scholarships and other aids to selected engineering schools in order to foster the education of students for the foundry industry. Before this post, he was general manager of Rogers Pattern & Foundry Co., Los Angeles.

GEORGE ARMISTEAD, JR., consulting chemical engineer for the petroleum, chemical, and related industries, has announced that his offices are now quartered in Suite 712, 1200 Eighteenth Street, Washington, D. C.

Heretofore a partner in the Wood-Work Co., San Francisco, **LOUIS S. WOOD** is now doing some special engineering development work on his own for the Day Brook Hydraulic Corp., Bowling Green, and the Ohio National Co., Upper Sandusky, Ohio.

HILMER E. LARSON, who is fleet and maintenance superintendent at Pacific Intermountain Express, Salt Lake City, Utah, has designed a new dual drive, diesel powered, aluminum tractor for P. I. E. He also designed a midget for advertising purposes which in every detail is one-half the size of regular hauling equipment. This midget is pictured at the right with Larson standing by it.

C. F. BREER, recently appointed sales manager of McCulloch Motors Corp., Los Angeles, had been assistant sales manager of this company for the past year. He will direct sales and advertising of the McCulloch lightweight industrial engines, as well as the target-aircraft engines built for the armed services.

GLENN V. EDMONSON has accepted an appointment as associate professor of mechanical engineering at the University of Michigan. He has resigned as staff engineer of the Hydraulic Coupling Division, American Blower Corp., Detroit. For more than 10 years, Edmonson has been associated with the development and application of the hydraulic coupling.

ROGER G. DELONG has been appointed manager of the Hydraulic Division of the Twin Disc Clutch Co. in Rockford, Ill. He had been serving as both acting manager and sales manager of this Division. He graduated from Purdue University in 1938 and a year later he joined the Twin Disc Clutch Co. as an installation engineer.

O. H. SOMERS, of the Standard Gage Co., Inc., Poughkeepsie, N. Y., has available to SAE sections and other professional groups for presentation a display and discussion of instruments for dimensional inspection and quality control. Professional in nature, the talk stresses cost reduction aspects of the selection and application of measuring techniques.

ARTHUR S. RANDAK has been appointed assistant to **C. M. LARSON,** chief consulting engineer of Sinclair Refining Co. Randak a graduate of Purdue University, spent three years with the Union Pacific Railroad, and joined Sinclair in 1937. Entering the Army five years later, he served in the Middle East, North Africa, Italy, England, Belgium, Holland, and Germany. His final military command was at Wright Field where, as a colonel, he was technical executive in evaluating German developments.

DAVID A. STODDART is now an engineer with Thompson Products, Inc. in Cleveland.

Recently graduated from Michigan State College, East Lansing, Mich., **ROY WILLIAM ROUSH, JR.,** has now become a junior engineer for the Electro-Motive Division of General Motors Corp., La Grange, Ill.

JAMES OTIS KING has accepted the position of layout engineer for the Baldwin Locomotive Works in Philadelphia. Prior to this he was an engineer with the Bear Mfg. Co., Rock Island, Ill.

ROBERT N. JUNTWAIT is now Washington representative for the Curtiss-Wright Corp. Prior to this, he was sales engineer for the Wright Aeronautical Corp. in Wood-Ridge, N. J.

Preceding his appointment as manager of the Motodrome Garage, Minneapolis, Minn., **MAX D. PETERS** was project engineer connected with the Continental Aviation & Engineering Corp. in Detroit.

EDWIN H. OLMSTEAD, who had been project engineer for Jack & Heintz Precision Industries, Inc., Cleveland, has now become a mechanical engineer for the Eaton-Dikeman Co., Mount Holly Springs, Pa.

No longer a project engineer for the Packard Motor Car Co., Aircraft Engine Division in Toledo, Ohio, **WILLIAM B. SEAVER** has become senior powerplant engineer for the Fairchild Engine & Airplane Corp. in Oak Ridge, Tenn.

Previously a sales engineer for Wright Aeronautical Corp. in Wood-Ridge, N. J., **T. F. BERGMANN** is now West Coast sales engineer for the company in Glendale, Calif.

Having been proprietor and manager of a motel in Inglewood, Calif., **ROBERT B. PATTERSON** has become partner and manager with Draves & Patterson Metal Products, Los Angeles.

HARRY C. DISHMAN was recently appointed equipment sales manager of Raybestos-Manhattan, Inc. with headquarters in Detroit. He joined this company in 1916 as development engineer and factory superintendent and was active in the development of molded brake linings and clutch facings. Dishman joined SAE in 1919.

DALE KELLY has left the Experimental Engineering Department of the Mack Mfg. Corp., Allentown, Pa., to become assistant professor of mechanical engineering at Lehigh University, Bethlehem, Pa.

Now connected with the Chandler-Hill Corp. in Detroit, **FRED L. HOELZEL** had been with the Hupp Corp., same city.

OBITUARIES

JOHN A. LUX

John A. Lux passed away on July 19 at his home in East Aurora, N. Y.

He had been manager of the Stewart Motor Co. of Buffalo. He began work with the Stewart firm when a young man and rose to become manager 10 years ago.

Lux joined SAE in 1944.

EWALD K. SCHADT

Ewald K. Schadt, who had been electrical engineer, Cadillac Motor Car Division of General Motors Corp., died on August 8 of a heart attack.

He joined SAE in 1923 and had been chairman of the Electrical Equipment Committee, Subcommittee IV - Fuses, Cable Terminals, Binding Posts and Switches at the time of his passing.

CHARLES Z. SMITH, 105 Grove Avenue, Albany 3, N. Y., has just published "Industries Answeright," a 440-p., illustrated volume of practical problems taken directly from engineering, production, and machine design departments. It also includes comprehensive outlines for determining dimensions for special and standard thread plug and thread ring gages. It solves many metal-working shop problems.

FREDERIC C. FEGLEY, formerly superintendent of flight test for Ranger Aircraft Engines, and previously service engineer of Brewster Airplane Corp., has been appointed service manager of Permafuse Corp., Brooklyn, N. Y., **S. G. TILDEN,** president, announced.

Heretofore an assistant project engineer for Wright Aeronautical Corp., Wood-Ridge, N. J., **JOHN L. DILWORTH** has become assistant professor of mechanical engineering at the Pennsylvania State College, State College, Pa.

Now in the employ of the Oldsmobile Division of General Motors Corp., Lansing, Mich., as senior project engineer, **HENRI E. BIRABEN** has been assistant passenger chassis engineer for Vauxhall Motors, Ltd. in Luton, England.

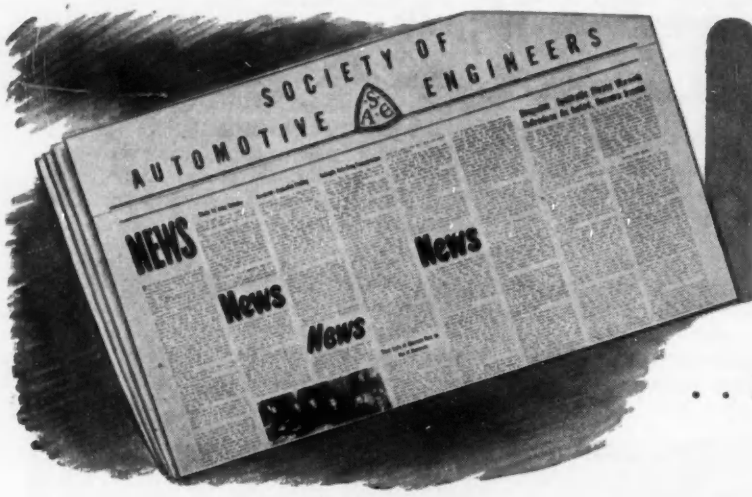
DR. FRANK C. CROXTON, formerly head of chemical research and **DR. CLARENCE H. LORIG,** formerly in charge of research in foundry technology at the Battelle Memorial Institute, Columbus, Ohio have both been made assistant directors of the Battelle Institute.

JOSEPH F. SLOMSKI is now employed by the Laboratory Equipment Corp. in Mooresville, Ind.

turn to p. 84

WINS WORLD SNIPE TITLE AT GENEVA

Winner of all five International Snipe sailing races at Geneva, Switzerland, **T. A. WELLS,** vice-president and chief engineer of Beech Aircraft Corp., Wichita, is shown here on Santa Fe Lake. Accompanying him as his "crew," his wife was replaced by a Swiss because of winds up to 20 mph during the international contest. The American flag was hoisted over Lake Geneva and cannons boomed to herald the world's champion as he sailed past the finish marker of the six mile triangular course. He won 1600 points to 1446 of the runner-up, an Argentine. Wells, a past-chairman of the Wichita Section and this year's Meetings Committee chairman, won the U. S. title off Marblehead, Mass. last July. Members of the New York Yacht Club honored him with a dinner on September 10.



News...
...OF THE SOCIETY

New Engineering Materials *Activity*

AN Engineering Materials Activity – twelfth in the structure of SAE Professional Activities – is now in operation, following its official recognition by SAE Council on Sept. 18. R. H. McCarroll has been named chairman of the new Activity Committee to serve until next January when the Vice-President representing Engineering Materials Activity – nominated and elected in the meantime – becomes chairman of the Activity Committee.

The spark for new Activity sprang from a constantly increasing exchange of information among SAE members on materials subjects, from growing technical committee interests in materials, and a gradually crystallizing demand among an important segment of the membership for official recognition of these developing interests. Forerunner of the new Activity was the Engineering Materials Meetings Committee which began to function in 1943 and which has been developing papers and sessions for SAE national meetings ever since. Characteristic of these sessions have been papers designed to bring materials information to all SAE engineers rather than to provide specialized data for metallurgists and specialists in non-metallic materials alone.

From now on the Engineering Materials Meetings Committee, like other Activity Meetings Committees, will continue to function under direction of the National Meetings Committee, but will be appointed by the Materials Activity Vice-President, who will become an ex-officio member of the Engineering Materials Activity Meetings Committee.

The Engineering Materials Activity Committee to serve with Chairman McCarroll until January is in process of being appointed. First task of this group is to elect seven voting members to serve as an Activity Nominating Committee to select a nominee for Engineering Materials Vice-President for 1948. Announcement of the nominating committee's selection will appear in SAE Journal as soon as it has been made.

Chairman of New Activity

R. H. McCarroll

Car Activity Back in Special Meeting Field

ADDED starter in the 1948 schedule of SAE National Meetings will be the important Passenger Car and Production Meeting approved for Detroit, March 3 to 5.

Built around a revival of the specialized Passenger Car Meeting which brought record attendance in the same city some years ago and an integration with the National Production Meeting to which Cleveland is host this year, the big combined gathering promises to be a major event in every respect. It will be sponsored by Passenger Car, Body and Production Activities.

George B. Allen, Chrysler Corp., has been named general chairman of the event.

Second important integration in the 1948 meetings schedule will be combination of the Spring National Aeronautic Meeting and the National Air Transport meeting into a single gathering in New York April 13 to 15. Name of the new meeting is SAE National Aeronautic and Air Transport Meeting.

Council Acts on Travel Expenses

"REQUESTS for payment of travel expenses of participants in SAE meetings will be considered by the Council only in exceptional cases," chairmen of SAE Activity Meetings Committees are being notified as a result of Council action at its Sept. 18 meeting.

Even such exceptional requests, Council has decided, "must be made by the Activity Meetings Committee concerned before any commitment is made with the proposed participant . . . and such requests must be received by the secretary at least 90 days before the meeting."

"Each request must show," Council action reads, "that the proposed participant is indispensable to the meeting program and that he is unable to arrange for payment of travel expense from any other source."

"Central Illinois" – Formerly Peoria

"CENTRAL Illinois Section" is now the official name of the former Peoria Section.

The new appellation stems from expansion of the Section's territory last April to include the Illinois counties of Menard, Logan, Mason, DeWitt, McLean, Macon, Fulton, and Sangamon.

The Peoria Section started functioning in 1945, following two years of preliminary operation as the Peoria Group.

By-Laws to Trail Constitution Changes

PROPOSED changes in the SAE's By-Laws had their first reading at the Sept. 18 Council meeting in Milwaukee. Designed to tie in with changes in the Society's Constitution now in process of consideration by the membership, the new By-Laws will not be made effective until after the Constitution changes have been finalized next Spring. Extended member action is required to make changes in the Constitution, but the Council has authority to change By-Laws through action at two Council meetings.

CRC By-Law Change Seeks to Clarify Aims

OFFICIAL clarification of the purposes and objectives of the Coordinating Research Council is sought in a proposed revision of Article 2 of the CRC By-Laws. The proposed revision would read:

"The purposes and objects of the Council are: To encourage and promote the arts and sciences by directing scientific cooperative research in developing the best combination of fuels, lubricants and equipment powered by internal combustion engines; and to afford the means of cooperation with the government on matters of national interest within this field."

If approved by both SAE and American Petroleum Institute – the sustaining members of CRC – and by the CRC Board of Directors, the change goes to the Coordinating Research Council itself at a special or annual meeting for final approval.

Represent SAE At French Event

HENRY L. Brownback, consulting engineer, and Maurice Olley, Vauxhall Motors, Ltd., have been designated by President Frudden as SAE representatives at the 20th Anniversary Meeting and celebration of the Societe des Ingenieurs de l'Automobile (SIA) Oct. 25 to 28, in Paris. Stanley Menton, General Motors Corp. Overseas Operations, has been appointed alternate.

Papers contributed to the program by SAE members include "Why Not a European Type Light Car in the United States?" by Henry L. Brownback; "Direct Fuel Injection for Spark Ignition Engines," by Frank C. Mock, Bendix Products Division, Bendix Aviation Corp.; "Diesel Engines of America" by F. G. Shoemaker, Detroit Diesel Engine Division, General Motors Corp., and "Recent Developments in American Automotive Manufacturing Methods" by Joseph Geschelin, Detroit editor, "Automotive Industries."

SAE National

FUELS & LUBRICANTS Meeting

The Mayo
Tulsa

NOV. 6-7

THURSDAY, NOVEMBER 6

9:00 A.M.

J. G. Moxey, Jr., Chairman

Practical Considerations in the Design of Motor Vehicle Fuel Systems for Freedom from Vapor Lock—Gilbert Way, Ethyl Corp.

Storage Stability of Gasolines in Automotive Fuel Systems—J. A. Bolt, Standard Oil Co. (Indiana)

2:00 P.M.

W. B. Bassett, Chairman

Progress Report on CRC Diesel Fuel Program—W. G. Ainsley, Sinclair Refining Co., W. J. Carthaus, Deep Rock Oil Co., and C. M. Ridgeway, Pure Oil Co.

The Effect of Diesel Fuel Characteristics on Engine Deposits and Wear—L. A. Blanc, Caterpillar Tractor Co.

Naval Experimental Station Experience with Diesel Lubricating Oils—W. F. Joachim, W. E. Robbins, M. S. Gordon and T. G. Timberlake, U. S. Naval Engineering Experiment Station.

FRIDAY, NOVEMBER 7

9:00 A.M.

J. E. Kline, Chairman

Evaluation of Light Aircraft Engine Lubricants—W. J. Backoff, N. D. Williams, K. Boldt, and J. G. Hall, Pure Oil Co.

Lubrication Problems Encountered in Light Plane Engines—C. T. Doman, Aircooled Motors, Inc.

Some Aspects on Valve Burning and Sticking—J. A. Newton, Thompson Products, Inc.

2:00 P.M.

C. O. Tongberg, Chairman

Preparation and Properties of High Viscosity Index Motor Oils—W. L. Van Horne, Rohm and Haas Co.

Sub-Zero Automotive Crankcase Oils—E. W. Upham, Chrysler Corp., and H. C. Mougey, Research Laboratories Division, General Motors Corp.

5:30-6:30 P.M. **Thursday & Friday** Social Hour

Social Hour Sponsored by the SAE Mid-Continent Section

7:00 P.M. **DINNER** Thursday

J. M. Campbell, Chairman

"The Petroleum Industry Public Relations Program"

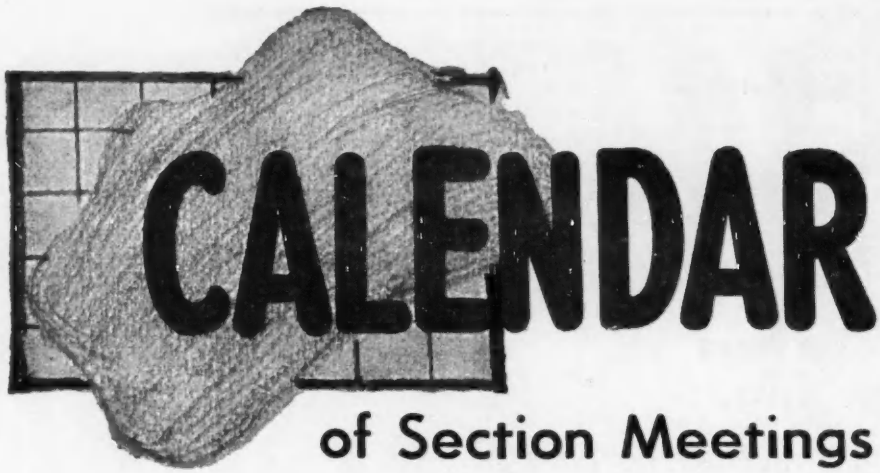
W. J. Arnold, Assistant Vice President in charge of Accounting, Pure Oil Co.

7:00 P.M. **DINNER** Friday

J. H. Baird, Chairman

"The Geography of Oil"

C. O. Willson, Editor, The Oil and Gas Journal



# of Section Meetings

Baltimore – Oct. 9

Engineers Club; dinner 7:00 p.m. Demonstration and plant tour through Koppers Co. Shops Division. Refreshments after tour.

British Columbia Group – Oct. 15

Georgia Hotel Vancouver; dinner 6:30 p.m. New Wide Base Rims – W. L. Hamlen.

Chicago – Oct. 14

Knickerbocker Hotel; dinner 6:45 p.m. David Beecroft Memorial Lecturer – Paul G. Hoffman, president, Studebaker Corp.

Detroit – Oct. 6 and 20

Oct. 6 – Dearborn Inn; dinner 6:15 p.m. Technical meeting – Edison Institute Theatre. Dinner speaker – E. R. Breech, executive vice-president, Ford Motor Co. Subject to be announced. Technical speaker – Harold T. Youngren, vice-president, director of engineering, Ford Motor Co. Subject – Passenger Car Designs. Mr. Youngren will use Edison Institute exhibit of old cars to illustrate his talk.

Oct. 20 – Horace H. Rackham Educational Memorial Building; meeting 8:00 p.m. Flight Beyond the Earth's Atmosphere – Dr. Francis H. Clauser, Johns Hopkins University. V-2 Rocket Tests – Lt.-Col. W. L. Clay, Ordnance Department, Technical Liaison Office.

Metropolitan – Oct. 15

Pennsylvania Hotel; New York; meeting 7:45 p.m. Fuels and Lubricants. Speaker and subject to be announced.

Mid-Continent – Oct. 3

Oklahoma A & M College, Stillwater; meeting 7:30 p.m. Vapor Conditioning of Fuel for Combustion – Lloyd E. Johnson, staff research engineer, Caterpillar Tractor Co.

Milwaukee – Oct. 3

Milwaukee Athletic Club; dinner 6:30 p.m. Flambeau Two-Cycle Outboard Engine – L. Kincannon, chief engineer, Metal Products Co.

Northern California – Oct. 14

Engineers Club, San Francisco; dinner 6:30 p.m. Recent and Future Developments in Diesel Engines – Saul Belilove, Enterprise Engine Co.

Northwest – Oct. 10

Gowman Hotel, Seattle; dinner 7:00 p.m. Bus Maintenance Practices – Earl Richardson, superintendent of equipment, Portland Traction Co.

Philadelphia – Oct. 8

Engineers Club; dinner 6:30 p.m. Combustion of Diesel Fuel Oils – M. A. Elliott, Research and Development Division, U. S. Department of the Interior, Bureau of Mines.

Pittsburgh – Oct. 22

Schenley Hotel; dinner 6:30 p.m. – meeting 8:00 p.m. Engineering Whys of the Modern Tractor – C. E. Frudden, consulting engineer, Allis-Chalmers Mfg. Co. and president, SAE. Motion Picture – Tractors at Work.

St. Louis – Oct. 14 and Nov. 11

Oct. 14 – DeSoto Hotel; dinner 6:30 p.m. Fuels of the Future – T. B. Rendel, assistant manager, Shell Oil Co.

Nov. 11 – DeSoto Hotel; dinner 6:30 p.m. Automatic Transmissions – Oliver K. Kelley, General Motors Corp., Product Study Section.

Southern California – Oct. 23

Rodger Young Auditorium, Los Angeles; dinner 6:30 p.m. Passenger Car Session. Racing Cars – Ralph DePalma. Other speaker to be announced.

Texas – Oct. 24

Ft. Worth meeting. Several of the nation's top automobile drivers who will participate in races at Arlington Downs to address meeting.

Twin City – Oct. 9

Curtis Hotel, Minneapolis; dinner 6:30 p.m. Problems Involved in Supercharging Gasoline Engines – Roger L. Weider, director of research, White Motor Co.

Virginia Group – Oct. 23

Hermitage Country Club, Richmond; dinner 7:00 p.m. Engineering Whys of the Modern Tractor – C. E. Frudden, consulting engineer, Allis-Chalmers Mfg. Co. and president, SAE. Motion Picture – Tractors at Work.

Washington – Oct. 14

National Bureau of Standards; meeting 2-4:30 p.m. Inspection tour through the National Bureau of Standards.

Wichita – Oct. 9

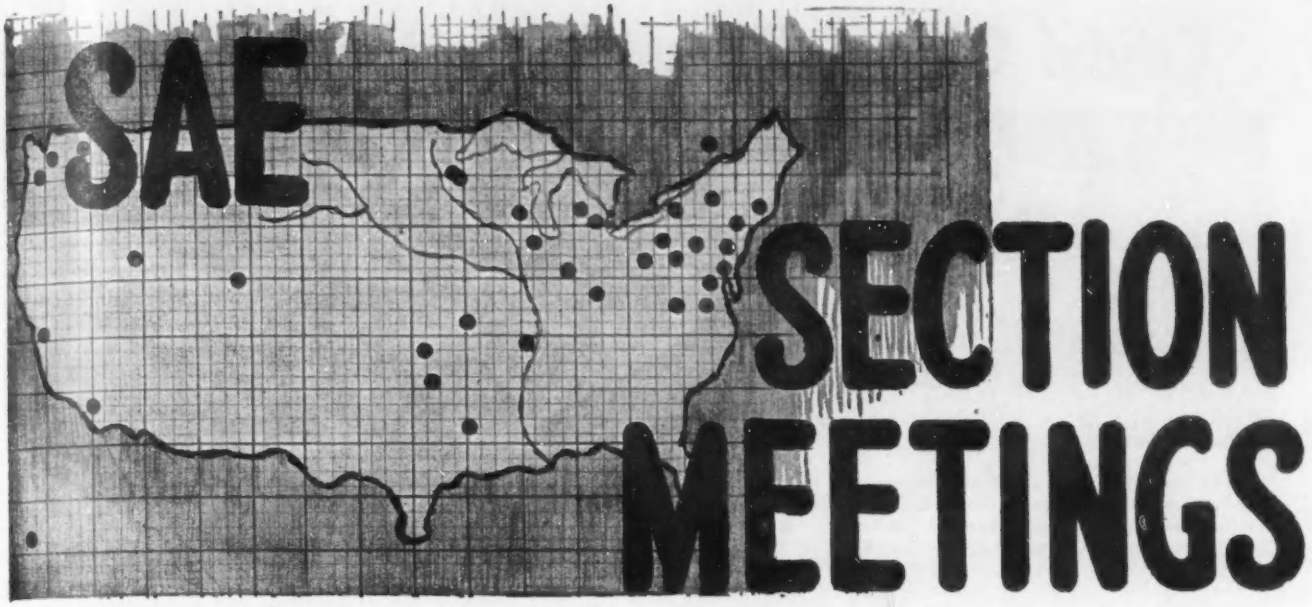
Drolls English Grill; dinner 6:30 p.m. Sail Boat Racing Here and in Switzerland – T. A. Wells, chief engineer, Beech Aircraft Corp.

Williamsport Group – Oct. 6

Anglers Club; dinner 6:30 p.m. Speaker and subject to be announced.

SAE NATIONAL MEETINGS

MEETING	DATE	HOTEL
AERONAUTIC (Autumn)	Oct. 2-4	Biltmore Los Angeles
PRODUCTION	Oct. 20-21	Carter Cleveland
FUELS & LUBRICANTS	Nov. 6-7	The Mayo Tulsa
AIR TRANSPORT	Dec. 1-3	Continental Kansas City, Mo.
ANNUAL	Jan. 12-16 (1948)	Book-Cadillac Detroit



Designs Advance for Fire-Fighting Trucks

by J. H. CARPENTER, Field Editor

WILLIAMSPORT Group, Sept 8 – Design of fire-fighting equipment began to have a scientific basis in the late 1930's, when modern conditions of streets, traffic, and buildings were taken into serious consideration, and fire chiefs all over the country were quizzed about fire-fighting needs.

Speaking on "Development of Modern Motorized Fire-Fighting Equipment," A. G. Sheppard, chief engineer of American-LaFrance Foamite Corp., described equipment history from horse-drawn steamers to postwar designs.

Modern trucks, he said, have the driver's seat placed ahead of the engine, for shorter wheelbase and overall length, and better maneuverability. This provides the best arrangement for men and equipment, because the driver's seat accommodates three men while two additional seats are provided on either side of the engine compartment.

The pump can be placed close to the engine so that hot air from the engine can be blown over the pump – an important facility in cold weather to prevent pumps from freezing.

Immediately back of the engine is the booster tank, with capacities from 100 to 1000 gal of water. This provides water for the fire as soon as the truck arrives, with no wait to connect hoses to an outside water source. Sheppard said 85% of all fires are extinguished by this means.

These pumpers can handle from 500 to 2500 gal per min at 120 psi pressure, but are also able to provide up to 500 psi pressure to force water to a height of 1100 ft. They carry up to 2000 ft of fire hose plus other necessary equipment.

The gasoline engine powerplants range from 170 to 240 hp. The same engine drives truck and pumps through a standard transmission with a take-off drive to the pumps. Pumps are two-stage centrifugal type, and a hydraulic pressure regulator is connected to the engine throttle to maintain constant pump pressure by varying engine speed.

Sheppard said a completely equipped truck weighs as much as 17,000 lb.

Aerial ladder trucks use the same arrangement of driver-ahead-of-engine for better traffic maneuverability. Extended ladder lengths usually are 100 ft, but have been built up to 125 ft. Some are wood, but most are steel, operated hydraulically, and able to swing through 360 deg.

A specialized type of equipment is the airplane crash truck. This type service requires a water fog or steam to blanket gasoline fires. The fog is used not so much to save the burning aircraft, he said, but to blanket flames sufficiently to permit rescue of passengers and crew.

Local Speakers Provide Varied Program at Peoria

by E. S. TOMPKINSON, Field Editor

CENTRAL ILLINOIS Section, June 9 – B-29 maintenance, truck wheel seals and sleeve bearings for internal combustion engines were cofeatures at Peoria Section's last 1946-1947 meeting, when three Section members presented papers.

James C. Porter, of the Department of Agriculture's Northern Regional Research Laboratory, described the maintenance organization of the 20th Air Force as it functioned on the Marianas. Supply and maintenance, he said, were divided into four echelons.

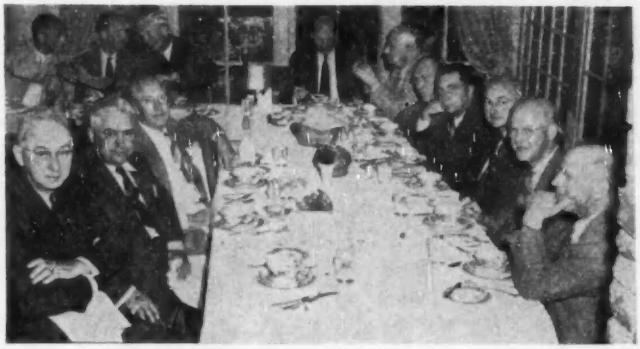
The first and second performed minor repairs, adjustments and replacement of parts on the group level. The third performed minor overhauls at service centers on the wing level with the use of heavy equipment. The fourth echelon comprised major overhauls done at Air Force depots with heavy, specialized equipment.

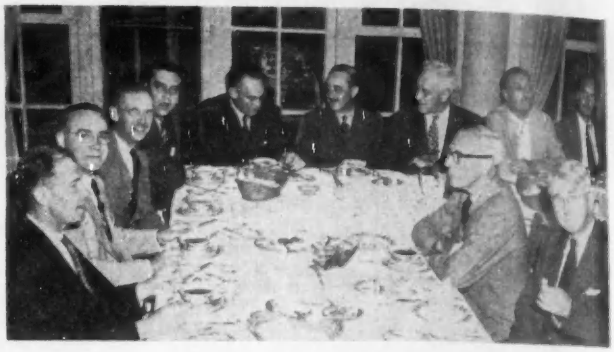
High humidity might have been a major problem, he said, but serious corrosion was prevented by improved methods of packing spare parts and by periodic operation of all electrical equipment to drive off moisture. The high moisture content of the air and the higher-than-standard-NACA outside air temperature affected the fuel-air ratio of the aircraft engines, and the "power settings" used had to be changed accordingly. Moisture in the distributors caused excessive "magneto drop" if the engines had not been "run up" for some time.

Porter described a variation of production line maintenance used in which aircraft specialists went from airplane to airplane removing and replacing defective parts or parts whose allowable hours of operation had been exceeded. These repairable parts then went to the service center or depot for repair and inspection before being returned as serviceable. Such a system resulted in a high degree of maintenance efficiency with a minimum of skilled personnel.

History of truck wheel seals was described by J. T. Liggett, assistant chief

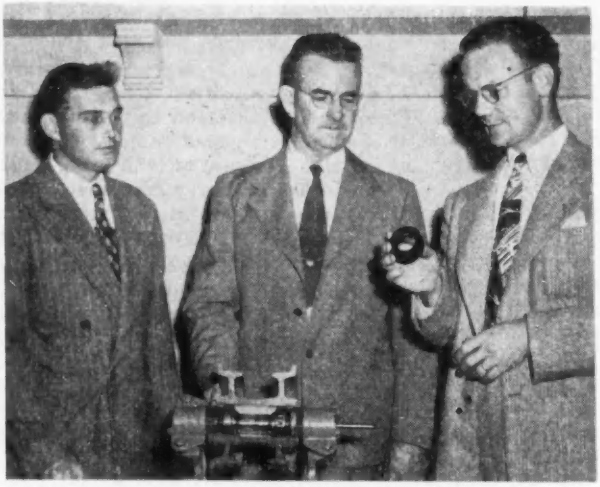
Candid Camera Finds SAE Sections in Action





Canadian Section members and their hosts at dinner at the Mississauga Country Club, July 24. Left: (l. to r.) C. E. McTavish, 1946-47 Section chairman; Adam F. Smith, chairman, Publicity Committee; and A. Frank Oliver, chairman, Program Committee; R. W. Richards, Section past-chairman; Ed. F. Armstrong, Section chairman; Marcus L. Brown, Jr., SAE Councilor and Section past-chairman; Norman H. Daniel, past-chairman; A. G. Partridge, president, Goodyear Tire & Rubber Co. of Canada, Ltd.; F. M. Buckingham, vice-president & general manager, Wallace Barnes Co., Ltd.; George Clermont, Section regional vice-chairman for Montreal; Frank G. King, editor, Canadian Section SAE News; Emerson L. Chant, Section regional vice-chairman for Oshawa; and Carl B. Cooper, general service manager, Goodyear of Canada.

Right: (l. to r.) Fred J. Beattie, Section regional vice-chairman for Hamilton; W. W. Taylor, treasurer; R. C. Berkinshaw, vice-president and general manager, Goodyear of Canada; Clifford E. Phillips, secretary; George W. Sawin, regional vice-chairman for Kitchener; Col. F. W. Miller, regional vice-chairman for Quebec; Warren B. Hastings, vice-chairman; R. W. Richards, Section past-chairman; Ed. F. Armstrong, Section chairman; James C. Armer, SAE past-councilor and Section past-chairman; and Alex Gray, Section past-chairman.



Speakers at Peoria Section's June 9 meeting were three Section members (left to right): James C. Porter, T. J. Liggett, and W. J. McCulla

engineer of Allis-Chalmers Mfg. Co. He traced their development from the original plain bearings with no particular seals, through cork washers, and leather lip seals up to the present seal assembly consisting of a spring-backed seal ring bearing against a flat seal plate of graphitic steel. Tapered roller bearings are used in the truck wheels. A test tank in which the truck wheel is run under a head of sand and water mixture gives an evaluation of seal effectiveness.

W. J. McCulla, of Caterpillar Tractor Co., presented a survey of bearing materials currently used in internal combustion engines, and explained how each material fills, in varying degree, certain conditions required for satisfactory service. No one material can be said to be best, since some particular conditions are better met by one bearing material than by others. These conditions include load, periodic

■

Northern California Section's newly-elected Governing Board. Standing, left to right: J. H. Pickup, vice-chairman for Aeronautics; W. C. Nostrand, treasurer; J. H. Macpherson, Jr.; E. J. McLaughlin; R. W. Muchmore; L. W. McLennan, vice-chairman for Fuels & Lubricants; J. R. MacGregor, Section representative to National Nominating Committee; Elton B. Fox, field editor; J. A. Edgar, Section representative to National Sections Committee; S. E. Onorato, meetings chairman.

Seated, left to right: H. N. Taylor; J. P. Bourne; H. J. Bihler, House chairman; R. W. Goodale, chairman; H. R. Porter, secretary; C. A. Winslow, past-chairman and reception chairman; E. L. Kearney, vice-chairman for Transportation & Maintenance; R. A. Hundley, general vice-chairman

President Frudden, Visiting Eight West Coast Sections, Is Photographed At Vancouver

British Columbia Group members at the Aug. meeting in honor of SAE President Frudden's visit to the Group. Above: Lawson Oates, president, Vancouver Motor Dealers Association; A. W. Notman, B.C. manager, Goodyear Tire & Rubber Co., Ltd., host of the meeting; President Frudden; H. D. Macdonald, Group chairman; and E. W. Rentz, Jr., SAE West Coast Branch Manager.

Right: Members of the Governing Board discuss activities with President Frudden. Back row (l. to r.) Treasurer Frank Davison, Secretary "Bud" Trout, and Vice-Chairman Harold Puxon. Front row: A. Gordon Scott, program chairman; President Frudden; C. S. Carswell, membership chairman; P. J. Schrodt, past-chairman

poor lubrication, possibility of dirty oil, misalignment and surface irregularity, high temperature, and corrosion. Aluminum alloys have recently become prominent bearing materials, and show promise of meeting satisfactorily most engine bearing requirements.

SAE President Frudden Tours West Coast Sections

West Coast Sections were host to SAE President C. E. Frudden from Aug. 6 when he landed in Spokane, Wash., until Aug. 26 when he finished his official tour at Salt Lake City. To all eight Sections he carried his message of modern tractor engineering trends, tracing the technical developments which have led to flame-throwing weed killers, cotton pickers, corn shuckers and other developments calculated to increase agricultural productivity.

At every meeting he was greeted by enthusiastic SAE audiences ranging from 75 to 140 – and in every city he was royally entertained by SAE Section officers and members. When he started back to Milwaukee, he had sampled a great variety of the scenic wonders and vast engineering achievements which have made the West so great. In something like quick succession he was treated to a special-guide inspection of Grand Coulee Dam near Spokane; points of municipal interest at Seattle; a boat trip to Vancouver, where he watched a small portable saw cut through a 4 ft thick, 200 ft tall tree in about 4 min; a ride up a ski lift to throw snowballs in August near Portland, Ore.; a ride around San Francisco bay in Charlie Winslow's boat; a visit to Consolidated-Vultee's plant in San Diego; a big welcome from the So. California Section at the National T&M Meeting there; and a visit to Magna Copper Mills and Kennecott Open Pit Mines near Salt Lake City.

He was accompanied on his trip by Mrs. Frudden, his daughter, Phyllis, and SAE West Coast Manager E. W. Rentz, Jr. He was at the Spokane Intermountain Section Aug. 5-6; Northwest Section, Aug. 8-9; British Columbia Group, Aug. 10-11; Oregon Section, Aug. 12-14; Northern California Section, Aug. 15-16; San Diego Section, Aug. 19-20; Southern California Section, Aug. 21-24; and Salt Lake City Group, Aug. 25-26.

Governing Board Guests of Goodyear

by WARREN HASTINGS, Field Editor

CANADIAN Section, July 24 – Members of Canadian Section's Governing Board were guests of the chief executives of Goodyear Tire & Rubber Co., Ltd., at a mid-summer golf tournament, luncheon, and dinner at the Mississauga Golf and Country Club. Hosts were A. G. Partridge, president of Goodyear and president emeritus of

turn to p. 79

SAE Section Chairmen

This is the second in a series of biographies of 1947-1948 Section chairmen. More Sections will be heard from next month.

WEBBER

. . . . of Colorado

Merle J. Webber has the unusual distinction of being born in a town that no longer exists. In 1901, the year Webber was born, Bald Mountain, was a rip-roaring Colorado mining town two miles from Central City. Now there is not even a single trace of this once booming mining town.

After Webber's family moved to Denver in 1913, he started his career in the automotive industry as a grease-monkey. From this apprenticeship he began to specialize in high altitude carburetion, learning this trade in the "school of hard-knocks" and by practical experience.

This hobby of carburetion lead him into the racing game. For a number of years Webber built racing cars and drove them in county fairs throughout the Rocky Mountain area. He has had many a thrill going through the fence on a slippery turn or over the bank on the old dirt road races between Denver and Colorado Springs or Denver and Cheyenne. His wife, who is a native of Oklahoma, finally persuaded him to lead a less active life. As a result of his experience in racing and carburetion he became distributor in the Rocky Mountain area for the Marvel carburetor.

Since 1927 Webber has been a partner in the Central Supply Co. of Denver. This company is a distributor of automotive, electrical, and carburetor supplies for Colorado, Wyoming, New Mexico, and Nebraska. The firm is well-known throughout the Rocky Mountain area.

During World War II, in addition to distributing parts to commercial fleets and military vehicles in this area, Webber helped operate a light plant rebuilding shop servicing all units used on the ALCAN highway. He also supervised building of motor generator power equipment used to drive test equipment for the Lowery Field turret school.

He is one of the men behind the scenes who is always on hand doing a big share of the work. He is quiet and unassuming. When he starts a project, things begin to hum.

With his two black cocker spaniel hunting dogs he is able to swipe enough time from business to get a few ducks and pheasants in season. His work in SAE since 1927, his Masonic work, his favorite hobby of hunting and fishing, and his business keep him fully occupied.

Because of Merle Webber's specialty in high altitude carburetion, he is widely known in the Rocky Mountain area. Through these numerous contacts he has helped build the prestige of the Colorado group of SAE.

– by Kenneth G. Custer, Field Editor

GARDNER

. . . . of New England

Early tinkering with a Model T turned Robert Gardner's attention to things automotive and turned his career toward truck operation. Manager of the automotive department of Lever Bros. Co. after about six years with the company, he has charge of the purchase and maintenance of more than 1200 cars and trucks. He has had this position for about four years.

But before becoming land-bound, he was with the New England Marine Sales as service representative and kept yachting customers as happy as he could by helping them to keep their Elco and Gar Wood engines purring softly off the rugged shoreline of his native Massachusetts and nearby states.

Educated in machine shop practice, ship design and calculation, diesel engines, and industrial management at Wentworth Institute, Franklin Union, Lowell Institute, and Tufts College, he joined Lever in sales and advertising work, but soon got back into automotive work again. His fleet operates throughout the United States.

Active in the U. S. Coast Guard Auxiliary, Bob is an expert swordfisherman, enjoys extended cruises, and is building a camp on Buzzard's Bay, a choice spot for a man with these hobbies.

His earnest interest in the New England Section augurs well for an interesting season.

– by Arnold R. Okuro, Field Editor

AITKEN

. . . . of Northwest

Murray Aitken remembers starting his career as a draftsman for $3 a day, when Kenworth Motor Truck Corp.'s engineering department had three engineers. He joined Kenworth immediately after graduating from University of Washington, and now is plant manager in charge of all plant and production facilities.

One of Aitken's first jobs was to make truck layouts for the first factory-built diesel-powered truck manufactured in the United States. It was a 4-cyl job that ushered in a new era in truck manufacture.

He also made layouts for the first of Kenworth's 600 series buses. Frameless and with an 11-in. floor height, these buses were quite radical.

Four years with the Navy, from which he emerged a commander, were spent assembling and repairing aircraft, aircraft engines and accessories.

Aitken, proud father of two daughters, Judith, 7, and Susan, 5, is calm, collected, and efficient, and is well known for his quiet, dry sense of humor.

– by Donald M. Grimes, Field Editor

Left to right: Merle J. Webber, Robert Gardner, Murray Aitken

the Safety League; R. C. Berkinshaw, vice-president and general manager of Goodyear and president of the Canadian Manufacturers Association; and R. W. Richards, vice-president of Goodyear and a past-chairman of the Section. Among those present were all the senior officers and six past-chairmen of the Section, one of whom, Alex Gray, expressed the guests' appreciation with characteristic whimsical humor.

Major Richard L. Johnson, speaker at Indiana Section's Sept. 11 meeting. Johnson spent 17 months overseas during the War, and is credited with 180 missions in P-47 Thunderbolts. He is recipient of the Air Medal with 12 oak leaf clusters, the Distinguished Flying Cross with two oak clusters, and the Silver Star

High Fighter Speeds Unleash New Problems

by ROBERT T. JACKSON, Field Editor

INDIANA Section, Sept. 11 – Unsolved problems of aircraft flight in the subsonic and transsonic ranges remain many and varied, according to Major Richard L. Johnson, of the Flight Test Division, Air Materiel Command, Wright Field, at this Section's aviation meeting.

Speaking on "High Speed Flight," Johnson named armament as one of the problems receiving major attention at this stage of high-speed fighter progress. In high-speed aircraft of the jet type, much of the available thrust may be lost through the armament installation, because of the peculiar design required by extremely high speeds currently achieved.

For example, about 1400 lb thrust may be absorbed by one recent type of fire control unit. Compared with a potential thrust available for flight of from 4000 to 7000 lb in current jet fighter experience, the 1000 to 1400 lb accounted for by the necessary armament is a factor of extreme importance.

Of course, he said, one reason for the use of intricate or remote-control fire power on these fighters is simply their terrific speeds, especially those relative to each other in the approach of a fighter to a hostile aircraft. At current speed rates for jet fighter types, a relative speed of 1000 to 1200 mph is not at all impossible.

Use of the aircraft itself as a rigid gun platform at these relative speeds is difficult if not impracticable – hence attempts to work out more accurate and dependable means of carrying and handling fire power than the conventional, stationary, optically-electrically sighted armament used on conventional fighters until recently.

Providing effective flight controls is another important problem. In high-speed aircraft operating at critical Mach numbers, a certain amount of aileron "buzz" is evident. This is the effect of high-frequency vibration that sometimes can be noticed visually at trailing edges of the ailerons. Danger here is obvious.

Another control phenomenon manifested at critical Mach numbers is a nose-down pitching moment of sufficient force to overpower elevator control. This effect sometimes is referred to as "tucking under." Up to now, the only means of regaining control when this occurs is to reduce power or use some form of dive flaps.

One approach to critical speeds is the sweptback wing. In most of these projected designs, the surfaces are at approximately 45 deg to the longitudinal axis. Even if sweptback wings are used, however, control in the transsonic and sonic ranges may be insufficient for safety. "Split" airflow or shock waves still are definite problems in many of the accelerations to which high-speed aircraft are subjected.

Accelerations of 14 g are not uncommon in jet aircraft operations today. The "anti-g" suits now under development have assisted in approaching this problem, but at present they do not offer complete protection throughout the possible range of acceleration. High-speed flight as such does not adversely affect the crew; it is only when the direction of the aircraft is changed that these accelerations come into play and become critical. Of course, as speed rises the seriousness of these changes increases. The problem of protecting the human body against the blackout effect of such accelerations is still not completely solved.

Among other concerns in connection with high-speed flight is the possibility of the crew's having to bail out of the aircraft, when inadverent contact with the aft portions of the ship would mean certain injury. Means for jettisoning canopies still are susceptible to improvement; in the past canopies have been suspected of "tucking in" and striking a pilot, usually with fatal results. In several past crashes it has been felt that this condition either contributed to or definitely caused pilot death.

One potential solution that has received much attention is the explosively jettisoned pilot's compartment. Among its difficulties is that of carefully proportioning the explosive charge so that the pilot may be safely discharged from the aircraft. This means a relatively slow start to avoid accelerations that might cause immediate blackout. This sort of start is not readily available with most explosives.

High-speed aircraft suffer from several other ills not particularly common to planes of more sedate performance. For instance, the radio beam does not always afford the same safety to high-speed aircraft because of problems inherent in high speeds. GCA, a radar routine employing the services of several ground operators who literally steer the pilot into a safe landing, does not work very satisfactorily with high-speed aircraft of the types presently in use. This is because the craft's great speed takes it near or past the landing area at the time landing is appropriate.

Instruments require improvement if high-speed flight is to make safe progress, Johnson warned. Up to this time inaccuracies in operation of flight instruments of the gyro type have been frequent and sometimes serious. In rough air or accelerations for turns and other maneuvers, certain instruments have lacked accuracy at speeds above 450 mph.

The still-serious problem of the jets' range in fuel hours is well known. Substantial improvements in fuel economy have been made in recent years, but still greater economy is desirable and necessary. Jets now have a remarkable range compared with their early performances, but the real significance of these improved ranges is limited by time as well as distance.

In addition, high-speed flight at altitude is rather difficult in the absence of effective means for keeping windshields, canopies, and other accessories free of frost and fog. One interesting approach to this problem has been experimentation with thin metallic coatings applied to canopies.

Silver, in such microscopic thicknesses that it does not interfere with vision, has been tried for this purpose. All efforts to date on conventional defrosting means have been unsuccessful.

Johnson pointed out, in conclusion,

that engineering along these lines is vitally necessary. Throughout his presentation he suggested details that properly should receive further attention if the pioneers in modern high-speed flight are to continue the remarkable gains made in the past few years.

Paper Approach to Design Saves Automotive Dollars

by C. W. THOMPSON, Field Editor

CENTRAL ILLINOIS Section, Aug. 25 – Engineers in Europe, awaiting the end of the war, devoted considerable time to mulling over and congealing ideas into forms that could be readily applied to experimental models after the war. So said C. G. A. Rosen, director of research for Caterpillar Tractor Co., when he reported at this meeting his "Impressions from European Engineering Societies."

Rosen pointed out that in the rush and hubbub of American industrial research we are too prone to list a large number of variables, then plunge into expensive and costly testing without giving due consideration to relatively inexpensive pre-evaluation of such projects based on pencil-and-paper diagnosis. He believes we could all profit by employing, to a greater degree, this fundamental approach which our European colleagues have been using to advantage.

Technically speaking, Rosen said, there is in Europe an intensity of interest in developments everywhere. Management does not have to be sold on the virtues of research on that continent because they have seen its results in financial gain, added business and greater production through the years.

A few of the more outstanding European developments Rosen mentioned included the development, by the Philips Co. in Holland, of the Erickson engine in a high pressure cycle that achieves high efficiency in heat transfer and produces 180 bmep in some very high speed units. The Delft Laboratories have accomplished some outstanding work in improving economy and efficiency of the Otto cycle, using gasoline motor fuels, as a result of new processes of catalytic cracking.

In Switzerland, where the gas turbine is in its most intensive state of development, the Sulzer people recently achieved a mixed cycle that incorporates the advantages of both the open and closed cycle systems; Brown-Boveri are continuing their efforts to make a complex system, utilizing high inertia gas impacts to achieve pressure levels of improved efficiency and economy; Escher-Wyss have an outstanding closed-cycle system; Oeleron have announced a new system for which they claim outstanding efficiency and economy.

Rosen feels that the Swiss engineers have done an excellent job in aerodynamics and hydrodynamics, and that these fundamental studies and research projects are achieving outstanding results in their application to the new gas turbine cycles.

In Sweden, an extremely simple 2-cycle loop-scavenged diesel engine has been developed with by far the fewest number of parts of any engine yet developed; the starting system is unique; and in an air compressor unit where scavenge air is provided by the lower side of the air compressor system, Rosen stated, there is a degree of simplicity achieved that would indicate that this new development has no competitors for simplicity of design and low construction cost.

New developments in torque converters with very broad efficiency curves are resulting in exceptionally fine performance of switching locomotives and military tanks.

Some of the German test equipment evolved during the war, he said, reached Switzerland without being uncovered by any of the technical missions to Germany . . . for example, the Zeiss hardness tester which has proved quite helpful in dealing with materials of hard, complex structure. Means also have been developed for using Schleren photography in aerodynamic studies.

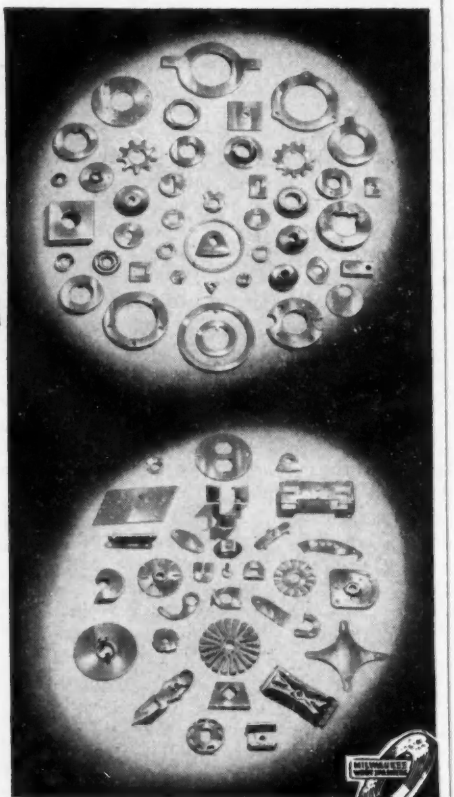
Some very simple devices have proved effective in the study of fluid flows; such studies have been of advantage to the Swiss in improving the efficiency and economy of gas turbines.

Ricardo, Rosen said, has done excellent work on 2-cycle loop scavenged high bmep plants, and has also developed a very simple uniflow scavenged 2-cycle engine using a single valve in the cylinder head as an exhaust valve and a horizontally-disposed single-orifice fuel valve for providing the injection of fuel into a hemispherical cup in the piston top. Freedom of choice of design of scavenge air ports around the entire circumference on the lower side of the cylinder is effective in providing bmep's from 80 to 100 lb at speeds of 2000 rpm and over.

England has some interesting developments for truck and bus engines. Having arbitrarily assumed necessity for cutting down initial powerplant cost from 20 to 25%, engineers are achieving considerable weight reduction and minimization of size in 100-hp units, by using a very simple type of uniflow single exhaust valve scavenge system, and positioning the fuel valve almost horizontal in the cylinder

60 YEARS OF SERVICE to INDUSTRY

SUPPLYING
WASHERS
and
STAMPINGS
OF EVERY DESCRIPTION
FOR EVERY PURPOSE...
UTILIZING MORE THAN
22,000 SETS OF DIES
Let Us Quote On Your Needs!



WROUGHT WASHER MFG. CO.
THE WORLD'S LARGEST PRODUCER OF WASHERS
2235 SOUTH BAY STREET • MILWAUKEE 7, WISCONSIN

head, so that excellent use is made of the violent turbulence provided by ports cut completely around the liner in the lower portion of the piston stroke.

Technical education is amplified in Europe by soliciting outstanding men in industry for part-time periods or short teaching sessions so that men in schools can benefit by the training and stimulation of contact with men of reputation in the industry.

Rosen concluded with a compliment for the enlightened manner in which European technical society meetings are held. He described the important and constructive part that chairmen played in a centenary meeting of the Institution of Mechanical Engineers – the way in which they synthesized what had been said on all sides of a subject in order to draw some warranted and valuable conclusions about future trends.

Discloses New Finish To End Lube Trouble

by WILSON B. FISKE, Field Editor

CLEVELAND Section, Sept. 8 – Members present at this meeting heard a pioneer in the field discuss the history of surface finishes as they pertain to cylinders, pistons, and rings of internal combustion engines. H. M. Bramberry, Sr., engineering consultant, covered the development of the many cylinder finishes, such as bored; bored and reamed; bored and honed; bored and ground; and mirror finished. Also discussed were the newer finishing techniques of knurling, knurled and filled, cellular etched, and porous chrome plating.

After discussing these techniques, Bramberry made the first public disclosure of his "characterized and filled" cylinder surface. During his work on this development, he said, he has accepted the inherent problems of the deformation of a metallic surface when it is manufactured, and also accepted lubricants as given to the user. Both were taken as the best science has to offer today. The accomplishments were made by introducing a medium and a design that allow achievement of the most possible with available materials.

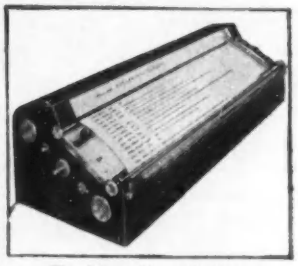
In Bramberry's opinion, his characterized and filled cylinder has eliminated boundary lubrication from the power zone of the engine. Boundary lubrication carries, almost by definition, the meaning that failure is imminent, operation being maintained at the borderline. He also believes the extremely hard cylinder surface offers little to the relief of the problem of surface disturbance, but might be of some advantage for operation under extremely dusty conditions.

Among the many recommendations made during presentation of the paper were two of particular interest: one, the finishing of piston skirts to 35-50 rms, thus permitting them to conform more readily; the other, tin plating of the faces of piston rings to bond the loss particles present, or vapor-blasting the face to remove them. Either process removes one of the major causes of scratching and otherwise damaging the cylinder surface.

The characterized and filled cylinder, he said, is the solution to the problem that troubles engine builders today – scuffing. Bramberry calls this condition surface disturbance of the pistons, rings, and cylinders. His "fix" consists of coordinating the phenomena of capillary attraction and surface tension.

By characterizing the surface of an internal combustion engine and filling this surface, the problem of surface disturbance is eliminated. Characterizing consists of breaking the surface into a multiplicity of isolated diamond-shaped plateau areas which act as individual heat dissipators and therefore prevent the spread of surface temperatures. This process alone is sufficient

New Automatic Device Provides Up-to-the-Minute Visual Record



The New Chart-O-Matic

The new CHART-O-MATIC provides an instant visual record of all production, shipments, purchases, absenteeism, etc. Avoids inventory surpluses. Guides purchasing department giving constant picture of all parts and supplies on hand. Requisitions can be made direct from chart. Information from all departments transmitted to operator by Telautograph permits instant recording on CHART-O-MATIC. Does away with big wall charts and card-systems and tedious, time-consuming search for data that is often far from current. With the CHART-O-MATIC, the complete activities of the entire plant can be determined in an instant.

The entire unit is easily portable and operates from 110 volts current. Chart rotates in either direction by finger-tip control. Speed may be governed by rheostat.

New devices are proving their worth in saving time and reducing nervous tension on the job. And modern plants throughout America are finding that chewing gum on the job helps relieve monotony and helps to keep workers alert. That is why more plants every day are making Wrigley's Spearmint Gum available to their employees.

Complete details may be obtained from Spiral Mfg. Corporation, 3612 N. Kilbourn Avenue, Chicago 41, Illinois.

AB-74

Specify

Titeflex flexible fuel lines

for longer life

The *first* cost is *not* the last cost when you install gasoline, oil, and air lines. Maintenance costs and replacement costs may greatly outweigh initial cost of tubing . . . unless you specify TITEFLEX flexible ALL-METAL fuel lines.

TITEFLEX will not bake, crack, or deteriorate despite high engine temperatures. It is absolutely tight and is not affected by gas, oil, or liquids. Yet TITEFLEX is fully flexible and holds up under excessive vibration.

Because of its longer service life, TITEFLEX flexible all-metal fuel lines actually cost less than rubber or synthetic composition or fabric packed hose. Insist on the best—specify TITEFLEX. Catalog on request.

Titeflex, Inc. 512 Frelinghuysen Ave., Newark 5, N. J.

Exclusive Manufacturers of Titeflex high quality products for more than 30 years

Sales Offices { CHICAGO CLEVELAND DETROIT PHILADELPHIA
LOS ANGELES BOSTON SAN FRANCISCO TORONTO

to greatly increase the load-carrying capacity of the cylinder and thus permit higher output without scuffing.

However, if the characterization exceeds 0.001 in. in depth, oil consumption is excessive and filling becomes necessary. This consists of filling the grooves with a phenolic resin high in carbon pigment. After this has air-dried, the surface is sprayed with a similar compound using micronized graphite as a pigment. The surface is then baked by radiant heat. The resultant surface is extremely porous and acts as a reservoir for oil. This combination of characterizing and filling brings about a new order of compatibility in engine cylinders. The engine need not be run in to insure perfect service, for scuffing will not occur. And the engine may be started at temperatures below 0 F, and full power may be taken immediately without damage to cylinders, pistons or rings.

Satisfactory operating is achieved when the relief of the cylinders is on the order of 25-35%. The above development was brought about by the fact that the nitrided steel piston rings Bramberry developed viciously attacked the nitrided steel cylinders upon which tests were conducted, and necessitated creation of a cylinder capable of carrying the loads involved.

Bramberry substantiated the extensive work behind this development by numerous photographs of the many test specimens. One of the outstanding slides was one of a section of a cylinder characterized and filled and charged with oil. This specimen was heated and the oil came from the porous filler and congregated in the centers of the plateau areas. Upon cooling, he said, the oil would again return to the filler. It is this use of capillary attraction of the filler and surface tension of the oil when on the plateaus that makes cold starting and compatibility possible. Oil control on a characterized and filled cylinder becomes easier to effect because the surfaces are compatible and surface disturbance not present.

In answer to a question, Bramberry said engine builders have reached the limit of high output with cast iron rings; but with a characterized and filled cylinder and nitrided steel piston rings, these engine components should last as long as the crankshaft.

The speaker's goal, he said, is an engine with a minimum operating life before overhaul, with components now available and characterized and filled cylinders, of 100,000 miles and an oil consumption of practically zero. He feels that the greater portion of the oil consumed today is wasted because with conventional cylinders it is necessary to over-oil cylinders, pistons and rings to keep the engine running without scuffing and scoring, particularly with diesels.

He pointed out that many of the practices in use today of surface treatment and surface coating are only tem-

porary, and that when they have worn away, the original problem again presents itself.

Bramberry and his son provided an interesting display of samples and test specimens which included nitrided steel piston rings and the original 1820 Wright aircraft cylinders that they claim led to the perfection of the Bramberry cylinder surface discovery.

The work originally was undertaken for the Army and Navy.

About SAE Members

cont. from p. 71

GAYLE L. SNYDER is now co-owner and operator of the Snyder Skelly Service in Sabetha, Kansas.

JOSEPH MODROVSKY, who had been design engineer for Wright Aeronautical Corp., Wood-Ridge, N. J., has accepted the post of assistant professor of Machine Design at the Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

JOHN K. NORTHROP, president of Northrop Aircraft, Inc., Hawthorne, Calif., has been awarded the Spirit of St. Louis gold medal, highest award of the American Society of Mechanical Engineers, for his development of a successful Flying Wing.

No longer a project engineer for the New Britain-Gridley Machine Co., New Britain, Conn., **HOWARD W. BUTLER** is assistant professor of mechanical engineering at the University of Connecticut, Storrs, Conn.

ROBERT I. STIRTON recently became connected with the Oronite Chemical Co. in San Francisco. He had been assistant manager of research for the Union Oil Co. of Calif. in Wilmington, Calif.

Formerly connected with the Chevrolet Motor Division of General Motors Corp., **THOMAS T. MAY** is now service promotion manager for the Hudson Motor Car Co. in Detroit.

A. F. CONE is no longer supervisor of the Quality Control Laboratories for the Glenn L. Martin Co., Baltimore, Md. He recently accepted the post of research engineer for the Harnischfeger Corp. in Port Washington, Wis.

MILTON C. EVERETT has become director of development and design for the Gilbert Mfg. Co., Long Island City, N. Y.

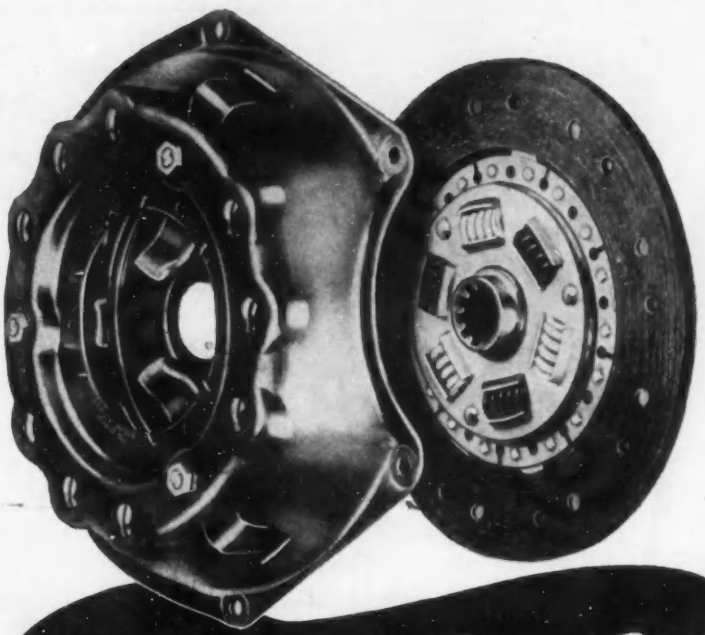
Having resigned as general manager of the Coca Cola Bottling Co., Honolulu, T. H., **B. J. EAVES** has accepted the position of vice-president and general manager of Dillingham Brothers' interests. Eaves is now serving as treasurer of the Hawaii Section.

PERCY A. WOOD, JR., is now C-54 fleet coordinator for United Air Lines, Inc., in Chicago.

Previously chief administrative engineer for the Aircraft Division of Willys-Overland Motors, Inc., Maywood, Calif., **CLIFFORD J. LEISY** is now an engineer for Boeing Aircraft Co., Seattle, Wash.

Heretofore an engineer for the Technical Service Co., Inc., Pasadena, Calif., **BURTIS E. DORRIS** has become a draftsman for Consolidated Vultee Aircraft Corp. in Fort Worth, Texas.

R. A. YOUNG has become United Air Lines representative at the Douglas Aircraft Co. in Santa Monica, Calif.



Engineered by Borg & Beck
means...MAXIMUM PERFORMANCE
MINIMUM MAINTENANCE!

You can depend on—
BORG & BECK
FOR THAT VITAL SPOT WHERE POWER TAKES HOLD OF THE LOAD!

BORG & BECK DIVISION
BORG-WARNER CORPORATION
CHICAGO 38, ILLINOIS

E. M. SCHNEIDER has accepted the post of mechanical engineer with the Bethlehem Steel Co. in Bethlehem, Pa. He had been application engineer for the Air Reduction Sales Co., Jersey City, N. J.

Heretofore a sales engineer for the Ladden Asbestos Co. in Brooklyn, N. Y., **ROLAND W. SELLIS** has taken a similar position with J. C. Mahoney, Inc., New York City.

RUD J. BABOR recently became vice-president of the Frontier Oil Refining Corp. in Buffalo. Previous to this post, he was manager of the Products Department, Richfield Oil Corp. of New York, New York City.

Now employed by the International Civil Aviation Organization in Montreal, Quebec, Canada, as technical expert, Operations Section, **FRANK M. BOOTH** had been vice-president and general manager of Canadian Aeromotive, Ltd., same city.

D. L. BENNETT is now chief engineer of production tooling for the Acme Steel Co. in Chicago.

DOLE Thermostats
IN A RANGE OF TYPES FOR EVERY CAR

In cars of advanced design—it is certain that positive motor temperature control will continue to be a highly important factor in achieving top-flight performance. Controlled cooling is the prime function of DOLE Thermostats...They provide quicker warm-up—plus substantial savings in gas, oil and motor wear.

THE DOLE VALVE COMPANY
1901-1941 Carroll Avenue • Chicago 12, Illinois
Los Angeles • Detroit • Philadelphia

A. S. KIEFER has accepted a position with the Visking Corp. in Chicago. Prior to this, he was automotive engineer for the Sinclair Refining Co., same city.

HENRY BERMAN is now mechanical engineer for the National Advisory Committee for Aeronautics in Hampton Field, Va. Prior to this post, he was stress analyst for the Republic Aviation Corp. in Farmingdale, L. I., N. Y.

JOHN L. SHANNON recently became a junior mechanical engineer for the Bridgeport Brass Co. in Bridgeport, Conn.

WELLWOOD E. BEALL, Boeing vice-president for engineering and sales, in August chairmanned an unusual "High Altitude Flight Symposium" held by the Boeing organization. Purpose was to examine at one time and one place every problem of high-altitude flight, every advantage, every limitation; to coordinate all existing information on design and operation of pressurized aircraft. In attendance were 250 leaders of the aircraft industry, U. S. and foreign airlines, of the AAF, of government and regulatory bodies. Keynote talk was by **EDWARD C. WELLS,** Boeing vice-president and chief engineer. Another SAE member who spoke was **G. W. NEWTON,** chief of Boeing's powerplant unit.

SEYMOUR J. DEITCHMAN is no longer an aeronautical engineer for the National Advisory Committee for Aeronautics, Langley Field, Va. He recently became senior research aerodynamicist for the Cornell Aeronautical Laboratory in Buffalo, N. Y. In 1944 Deitchman was president of the SAE Student Chapter at the College of the City of New York.

Now in the employ of the Arabian American Oil Co., Dhahran, Saudi-Arabia, as petroleum engineer, **JOHN P. CALLIGEROS** had been a mechanical engineer for the Bechtel Corp., Los Angeles.

Prior to becoming assistant to the general manager of the Indian Motorcycle Co. in Springfield, Mass., **G. LESTER JONES** was an aeronautical works engineer for Sperry Gyroscope Co., Inc., Great Neck, L. I., N. Y. He was on the 1946-1947 Membership Committee of the Metropolitan Section.

Student Branch News

Northrop Aeronautical Institute

NAI Student Branch members saw three films on aerodynamics at their June 19 meeting for members and guests. Subject matter of the films was a series of demonstrations put on by Franklin Institute to acquaint stu-

dents with the behavior of air flowing over and around airfoils and streamlined bodies.

Airflow over the wing sections at various angles of attack was made visible in the film by addition of "smoke" from dry ice to the airstream.

•

On June 26, members inspected the heat-exchangers and high-altitude cabin-pressure equipment produced by Airesearch Mfg. Co.'s Los Angeles plant.

Guided by Earl English and Roy Sands, production engineers, they watched the process of impact extrusion, used for making tubing for heat-exchangers, the assembly of

S.A.E.

MEMBER

available in

AUSTRALIA

NEW ZEALAND

PHILLIPINES

To act as part time consultant or representative for U. S. firm requiring a technical survey or report pertaining to export of Automobiles, trucks, tools or engineering. Until recently Service Manager and representative for Chrysler Export Corp. 18 years above territory. S.A.E. Member since 1929. Qualified engineer.

Write Box 208, S.A.E. JOURNAL
29 West 39th St., New York 18, N. Y.

S.S.WHITE METAL MUSCLES*
FOR POWER DRIVES **FOR REMOTE CONTROLS**

S.S.WHITE FLEXIBLE SHAFTS

provide automotive engineers with a simple, economical solution to the problem of driving accessories located anywhere in a car, bus, or truck. With one of these shafts, power can be taken from the engine or transmission and delivered to any point in the vehicle.

The same is true for accessories such as radios, heaters, air conditioners, etc., which require operational adjustments. With an S.S.White remote control type shaft, smooth, sensitive control can be provided between any two points. This allows the accessory to be mounted in any out-of-the-way spot with its control on the dash or at any desired point.

260-PAGE FLEXIBLE SHAFT HANDBOOK
FREE TO ENGINEERS

Gives full information and engineering data about flexible shafts and how to select and apply them. Copy free, if you write for it on your business letterhead and mention your position.

*Trademark Reg. U. S. Pat. Off. and elsewhere

S.S.WHITE INDUSTRIAL DIVISION
THE S. S. WHITE DENTAL MFG. CO.
DEPT. J, 10 EAST 40th ST., NEW YORK 16, N. Y.
FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RESISTORS • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

One of America's AAAA Industrial Enterprises

fractional horsepower electric motors, and the sandcasting of turbine blades with extremely thin webs.

In the strato-laboratory, Bob Kesler demonstrated the altitude chamber used for checking cabin-pressure controls. At the turbine laboratory, the visitors saw a turbine-overspeed test setup and also the complete mock-up of cabin-refrigeration equipment for the Convair 240.

Last stop was the heat-transfer section, where Duke Wallington explained methods used for accurate measurement of heat-flow.

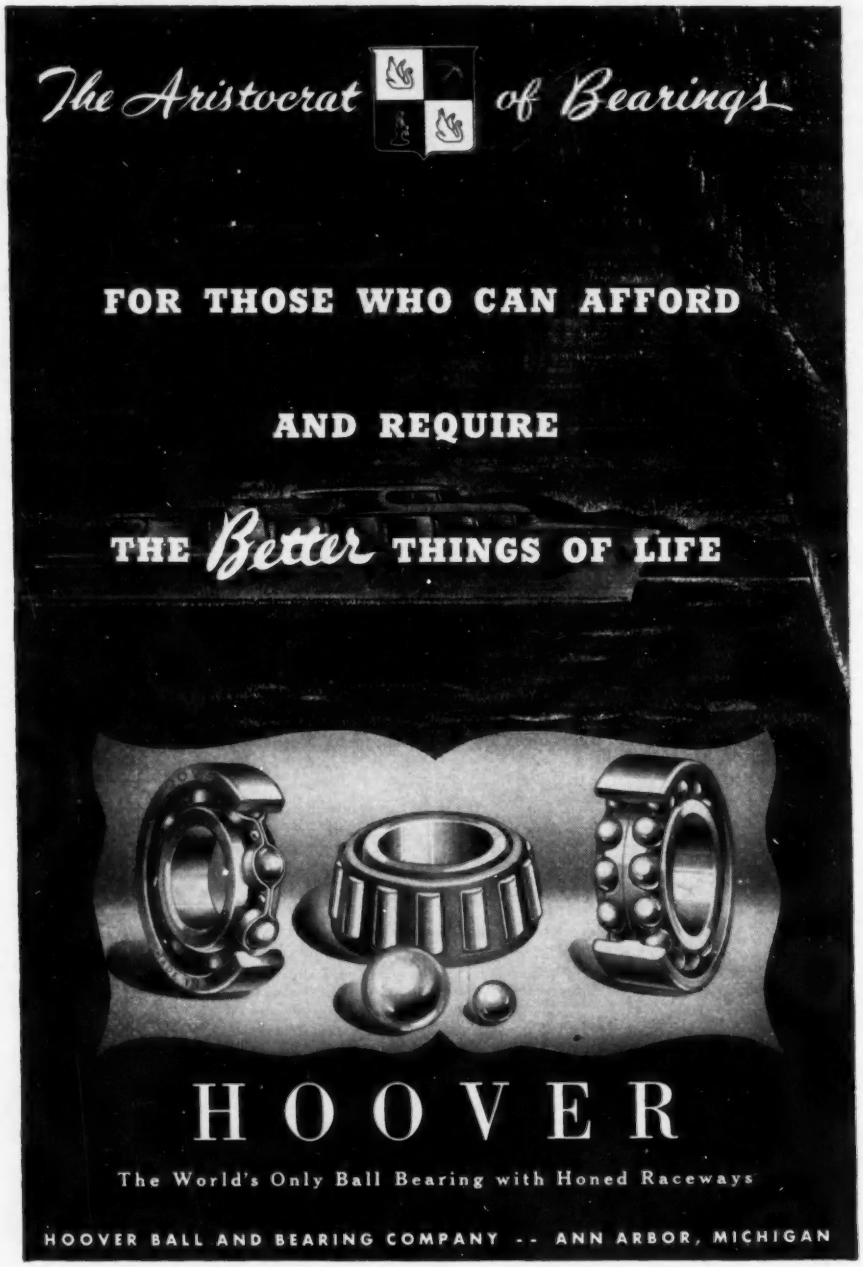
University of Wisconsin

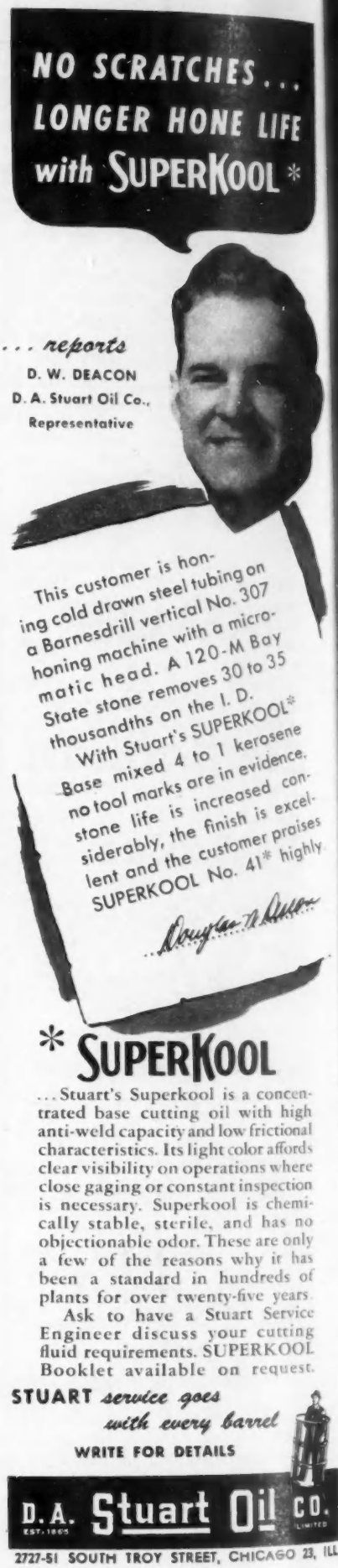
Student Branch members from University of Wisconsin learned much about engineering problems that are difficult to present clearly and impressively in the classroom when they toured the Wisconsin Motors Corp. plant in Milwaukee. The trip, made Aug. 16, was arranged by R. L. Switzer, Milwaukee Section field editor. Other Section members present included C. T. O'Harrow, 1946-1947 chairman; Chairman-Elect Ed Bryant; Secretary George Haislmaier; Reception Chairman Howard Miles; and Student Chairman C. H. Duguemin.

The morning was spent observing production methods, assembling, and testing, as applied to the manufacture of air-cooled gasoline engines. After the tour the group had lunch in the plant cafeteria and held a short informal discussion.

Students were particularly impressed by smooth efficient production lines and by high employee morale.

– by Harold C. Miller, Secretary


The Aristocrat of Bearings
FOR THOSE WHO CAN AFFORD
AND REQUIRE
THE Better THINGS OF LIFE
HOOVER
The World's Only Ball Bearing with Honed Raceways
HOOVER BALL AND BEARING COMPANY -- ANN ARBOR, MICHIGAN


NO SCRATCHES... LONGER HONE LIFE with SUPERKOOL *
... reports
D. W. DEACON
D. A. Stuart Oil Co.,
Representative
This customer is honing cold drawn steel tubing on a Barnesdrill vertical No. 307 honing machine with a micromatic head. A 120-M Bay State stone removes 30 to 35 thousandths on the I. D. With Stuart's SUPERKOOL* Base mixed 4 to 1 kerosene no tool marks are in evidence. stone life is increased considerably, the finish is excellent and the customer praises SUPERKOOL No. 41* highly.
* SUPERKOOL
... Stuart's Superkool is a concentrated base cutting oil with high anti-weld capacity and low frictional characteristics. Its light color affords clear visibility on operations where close gaging or constant inspection is necessary. Superkool is chemically stable, sterile, and has no objectionable odor. These are only a few of the reasons why it has been a standard in hundreds of plants for over twenty-five years.
Ask to have a Stuart Service Engineer discuss your cutting fluid requirements. SUPERKOOL Booklet available on request.
STUART service goes with every barrel
WRITE FOR DETAILS
D.A. Stuart Oil CO.
2727-51 SOUTH TROY STREET, CHICAGO 23, ILL.

Silicone News

DC SILICONES

PHOTO COURTESY COLLMAN MANUFACTURING CORP.

DC 44 Silicone Grease is used to lubricate this new electric shaver made by the Collman Manufacturing Corp.

FOR A LONG LIFE OF TROUBLE-FREE SERVICE

In electric shavers or locomotives, the basic requirements are the same—long life and trouble-free service. These requirements are met by designing and redesigning to capitalize on the properties of the best materials available.

The kind of lubricant used is frequently as important as the materials of construction or the tolerances and workmanship. An unusual example is the experience of Collman Manufacturing Corporation of Erie, Pa., makers of the Collman "58" electric shaver.

In this shaver a small four pole motor on a case hardened steel shaft rotates at high speed in plastic laminated bearings. Many organic greases were tried, but none of them had enough lubricity to increase the original speed of the motor. But use of DC 44 added 1500 r.p.m.—proof of its excellent lubricity between hardened steel and plastic bearings.

And DC 44 stays where it's put. Bleeding of DC 44 is less than 2% after 16 hours at 110°C. That means more permanent lubrication. It also means more trouble-free operation in this application where the electrical contact points are only half an inch from the bearings. Organic greases migrated, decomposed on the contact points, and stopped the motor. DC 44 has less tendency to migrate and it does not decompose to form troublesome gums or sludges.

In the trend toward really permanent lubrication the DC Silicone Greases are inescapable. You'll find them described in data sheet No. D7-5.

DOW CORNING CORPORATION
MIDLAND, MICHIGAN
New York • Chicago • Cleveland • Los Angeles
In Canada: Fiberglas Canada, Ltd., Toronto
In England: Albright and Wilson, Ltd., London

Dow Corning
FIRST IN SILICONES

Rensselaer Polytechnic Institute

First meeting of RPI Student Branch members, Sept. 11, opened with the announcement that the former Student Club has been recognized as a regular Student Branch. About 100 students were present to hear Chairman Gene Zak discuss the purposes of SAE and its place in the life of engineers, both as students and as members of industry. Pamphlets explaining SAE and applications for student enrollment were distributed to newcomers at the meeting. Students were introduced to Dale Brown, new faculty adviser, and to the officers of the Branch.

Speaker of the evening was Austin M. Wolf, consulting engineer, who spoke on "Automotive Suspension and Powerplant Placement." Wolf explained the underlying principle of suspension system design as it is affected by the mass ratio of sprung to unsprung weight. The mass distribution of a vehicle, he said, is governed by the forces exerted as it travels.

Conventional placement of the engine is in the front of the vehicle, and the weight of the engine limits its placement in other sections of the vehicle without considerable redesign. If sprung weight is large compared with

BUT . . .

. . . Today's giant high-speed, automatic marvels have left it far behind. As in printing progress, so it is in the field of metal cleaning and conditioning.

Duridizing With

Duridine*

CHEMICALS ACP PROCESSES

RUST PROOFING AND PAINT BONDING
Granodine *
Duridine *
Alodine *
Lithoform *
Thermoil-Granodine *

RUST REMOVING AND PREVENTING
Deoxidine *
Peraline *

PICKLING ACID INHIBITORS
Rodine * ®

is the modern method for cleaning and conditioning metal surfaces—removing oil, grease and other undesirable soil. DURIDINE also phosphatizes—creates a durable bond for inorganic finishes by changing the metallic surface into a non-conductive phosphate film of uniform crystalline texture.

DURIDINE is best used in power spray washers of mild steel construction. The process is simple, requires little special training—no exacting technique in the use of the single chemical "DURIDINE."

For lasting protection of painted sheet-metal products—DURIDIZE!

AMERICAN CHEMICAL PAINT CO.
AMBLER ACP PENNA.

unsprung weight, as when the engine is directly over the wheels, the vehicle will ride smoothly.

Advantage of front-wheel drive for better acceleration is outweighed by rear-wheel drive's advantage of better traction over all types of terrain.

A series of slides showed the suspension systems of many foreign vehicles and how they differ from the usual American car system.

– By Howard Roberson, Field Editor.

One of the strongest selling statements that can be made regarding any engine-powered equipment is this:

"It's Powered with a FORD-BUILT ENGINE!"

Engines available through district sales offices of Ford Motor Company or through Ford Dealers. Universal Ford Service always available everywhere.

Ford

FOURS
SIXES
V-EIGHTS

Write For Latest Industrial Literature

Address:

FORD MOTOR COMPANY
Industrial and Marine Engine Department
3511 SCHAEFER ROAD
DEARBORN, MICHIGAN

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Aug. 10, 1947, and Sept. 10, 1947.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

British Columbia Group: Robert McKenzie Adamson (A), Pat J. Conlin (A), Harry Thomas Dorris (A), George F. Lloyd (A), George W. Mac Adam (A).

Buffalo Section: Elliot W. Chapman (J), Harry C. Oakes, Jr. (J), Chester M. White (M).

Canadian Section: William Ferrier Allan (A), Thomas Edmond Bingham (A), Clifford Ormond Bowen (J), William Hugh Cockburn (A), Arthur William Frazer, Jr. (J), Hugh McPherson (A), Arthur Ernest Russell (A).

Chicago Section: Paul C. Baker (A), Donald S. Berry (M), Howard S. Bowen (J), D. Shonts Campbell (A), George H. Daskal, Jr. (J), Laurance H. Gillick (M), Donald Phipps Goddard (J), Richard S. Graafsma (J), Edward H. Gustafson (A), James Roy Haynes (A), Rudolph A. Holmberg (M), Col. Miles A. Kinley (M), Hugh C. Lafferty (J), John Allan MacLean (M), Emil F. Moreno (J), Kenneth D. Roubie (A), Toiva J. Salo (A), G. D. Smith (A), Edwin Warder Tanouary (M), Harold C. Tellock (M), Rhode C. Tesch (A).

Cincinnati Section: Edward B. Lohaus (J), Frank A. Tiedge (J).

Cleveland Section: Fred R. Allin (M), Fred E. Amon, Jr. (A), Glenn W. Bailey (J), Merrill G. Beck (J), F. S. Butcher (A), Lee Cirillo (M), Hugh S. Highet (M), Norman Frank Jirousek (J), O. J. Kelley (A), K. Theodore Korn (M), Edward H. Lisowski (A), Arthur J. Shull (A), Kurt R. Weise (M).

Dayton Section: Norman F. Trost (J).

Detroit Section: Martin L. Alspaugh (M), John H. Austin (M), Albert Beauchamp (M), Alphonse W. Berard (A), James T. Conwell (J), William John Cooke (A), Charles F. Dye, Jr. (J), Bernard F. Fountain (J), Albert W. Gair (A), Dan M. Guy (M), Frank W. Hartman, Jr. (J), Duane S. Hefty (J), Clarence A. Herman (M), Allen D. Krugler (M), Howard Robert Lange (J), Clifford M. Manzer (M), Paul M. McLaughlin (J), Carl Edward Montray (A), Geo. B. Noll (A), Oscar Oldberg (M), Robert L. Redmond (M), Donald F. Reynolds (M), Elmer P. Robinson (A), Paul F. Stibbard (J), Robert E. Thibodeau (M), William A. Tururen (J), Walter Unterberg (J), Albert F. Vandenbergh (J).

Hawaii Section: Ferdinand C. Hons (A), J. H. Rastatter (A), John Davis Singleton (A), William F. Smarz (A), Nathaniel Ewing Warman (A).

Indiana Section: E. M. DeCoursey (M), Walter E. Johnson (J).

Kansas City Section: Rupert Allen Jarboe (M), Allen O. Tilton (A), Robert K. Wattson, Jr. (J).

Metropolitan Section: Frohman Anderson (M), Anderson Ashburn (J), Frank E.

SPILLAGE IS WASTE!

THE VENTALARM* whistling tank fill signal for automotive gas tanks, is the answer! VENTALARM assures adequate venting . . . eliminates "dribble" filling . . . does away with the three types of spills: blowbacks, overfilling, and spillage due to expansion.

VENTALARM* saves plenty of gas. Car and fleet owners know and appreciate this fact . . . they want VENTALARM! Automotive engineers are now recognizing that *easy-filling, non-spilling* gasoline tanks are an essential requirement of good automotive design.

SCULLY SIGNAL COMPANY
CAMBRIDGE 41, MASSACHUSETTS

VENTALARM
GAS TANK FILL SIGNAL

Bremer, Jr. (J), Norman Everett Briggs (J), John L. Chilton (M), Robert E. Coleman (J), Edward V. Cordes (A), Ben R. Czyewski (A), Stewart C. Fulton (M), Irving Granet (J), Paul Louis Hlesciak (J), Frank R. Hormann (M), Robert James Jackson (J), T. Curry Jones (J), William Velsor Lessels (A), Joseph G. Liscouski, Jr. (M), M. V. Little (A), Kjell O. Nilsson (A), Frank N. Pagano, Jr. (A), Robert W. Scott (M), Guy E. Soper (M), Max Herbert Spiegel (A).

Milwaukee Section: James Raymond Davis (J), Kurt Ernst Hohnl (J).

Mohawk-Hudson Group: J. F. Cage, Jr. (J).

New England Section: Frank Alward (A), Robert Gilman Ballard (M), Edward S. Thompson (M).

Northern California Section: George Wayne Elliott (A), Forest Winton Fingerle (J), Morris Hayden Pomeroy (J).

Northwest Section: Benjamin P. Bump (A).

Oregon Section: John William Cannon (A), Willis Harrison Stevens (A).

Peoria Section: John R. Gardner (J), Harlow H. Piper (J), James W. Sydnor (J).

Philadelphia Section: George D. Fraunfelder (M), James L. Gregg (M), Henry I. Hoot (SM), Isaac M. Sheaffer, Jr. (J), Miles Seymour Trumble (J), Henry B. Wilmer (J).

Pittsburgh Section: Daniel Durie (M), Charles Rallya Scott (J).

Salt Lake Group: Don P. McStocker (A), James R. Williams (A).

Southern California Section: Bennie G. Ayala (A), Louis A. Borener (A), Thomas Walter Boyd (M), Harold E. Carlson (J), Milford D. Gibson (A), Ivan G. Heady (J), James R. Neal (A), Robert Q. Parsons (M), Frank John Pausic (J), Otto A. Scholz (A), Marion A. Scott (J), Charles F. Thomas (M), Edward F. Weiss (J).

Southern New England Section: Karl H. Falk (M), Milton L. Gearing (M), Bruno John Pawlowski (J), Malcolm E. Wallace (A).

Spokane Intermountain Section: Keith W. Tantlinger (J).

Texas Section: H. M. Fox (J), Hugh L. Jacobs (M).

Virginia Group: M. M. Clements (A), George W. Eary (A), Winnon Binford Leake (A), W. G. Raeburn (A), Randolph Peyton Saunders (A).

Washington Section: Ensign Marshall James Corbett (J).

Wichita Section: Herman D. Barnett (M), Richard N. Cooper (A).

Williamsport Group: Robert H. Ammon (J).

Outside of Section Territory: K. W. Anderson (A), Harry A. Bishop (A), Thomas W. Holt, Jr. (M), Charles Ward Leister (J), William Warren McCutcheon (A), Walter Burke Starks (J), Brig. Gen. Gordon M. Wells (SM), S. Arthur C. Witten (A).

Foreign: Ralph Alan Stavert (FM), India; Eric William Thomas Stow (FM), England; Jose Telleria (A), Spain; Pier Luigi Torre (FM), Italy; Philip Edward Burduck Vaile (J), England.

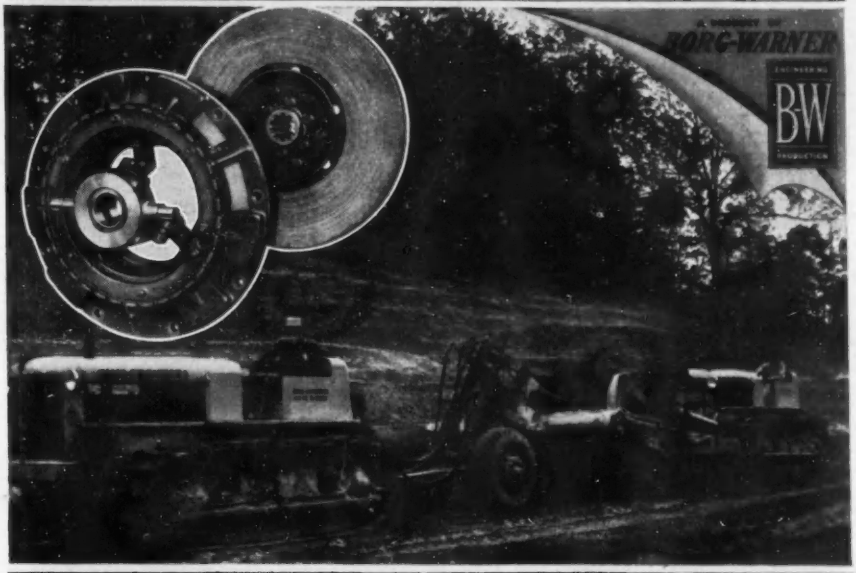
Applications Received

The applications for membership received between Aug. 10, 1947, and Sept. 10, 1947, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section: Walter W. Immel.

British Columbia Group: Edward C. Howell, Stanley A. MacKenzie.

ROCKFORD



OVER – CENTER
CLUTCHES

EASY OPERATION
HIGH TORQUE
POSITIVE ENGAGEMENT
LARGE DRIVING AREA
SMOOTH RUNNING
INFREQUENT ADJUSTMENT
MINIMUM INERTIA

* The ROCKFORD Over-Center CLUTCH has a spring steel adjusting ring plate which yields slightly as the roller cams go over center thus relieving the back plate of strains. A spring-loaded effect holds the clutch firmly in engagement and distributes pressure evenly. Its hard surface and freedom to float practically eliminates wear. The adjusting ring is threaded for accurate, easy adjustment.

Send for This Handy Bulletin

* Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD CLUTCH DIVISION BORG-WARNER
316 Catherine Street, Rockford, Illinois, U.S.A.

Chicago Section: John R. Danly, Joseph F. DiVito, James Russell Downey, W. D. Hissem, Roy Kamo, Joseph Louis Nemeth, Leonard F. B. Reed, Francis R. Rogers, Edward William Ruehrwen, Jr., Ahmed Mohey-eddin Salhab, Noble R. Tucker, J. N. Waddell.

Cincinnati Section: Richard M. Stanley.

Cleveland Section: Harry B. Biersdorfer, LeRoy Albert Difford, John W. Douglas.

Dayton Section: Robert H. Lundberg, Thomas O. Mathues, Tommy J. McCuistion.

Detroit Section: James Dean Campbell, Earl S. Clifton, Paul L. Cronin, Robert G. Cummings, Richard H. Diesel, John Harry Douma, Arthur William Edmond, James Gerity, Jr., Nestor Raymond Gorris, Charles Norman Haskins, Norman William Hopwood, Jr., Robert Warren Hornbeck, Taga E. Juul, Alexander Marderian, Philip Armand Martel, Charles Grant McDougall, Ira Wesley Nichol, Robert B. Palmer, Emile Loyola Provost, Kenneth Eugene Pyle, Conrad N. Reuter, Theodore A. Schaad, J. F. Schraegle, Herbert G. Sood, Leo F. Stone, Walter H. Street, Kenneth L. Swarthout, Sr., Tom H. Thompson, Morrison T. Wade, Denis P. Walsh, Donald Graham Wright.

Hawaii Section: David Hyman Meyer, Harold F. Schaffner.

Indiana Section: Arthur Walter Christy, Grant M. Rhode, Jr., Joseph Frank Slomski.

Metropolitan Section: Earle L. Barker, Herman H. Bement, Martin D. Davis, David M. Denzer, Frank E. Hinckley, William H. Hoops, Eugene Marshack, Paul H. Portteus, Arthur S. Randak, Harry Nelson Riker, John G. Stapler, Harold Reynolds Towers.

Milwaukee Section: Daniel R. Nettesheim.

New England Section: David Allen Hoffman.

Northern California Section: Harry G. Nagel, Robert W. Roth, Harold Eugene Stoner.

Oregon Section: John Thomas Roberts.

Peoria Section: Roy F. Kern, Arthur H. Pickford.

Philadelphia Section: William D. Harshbarger.

Pittsburgh Section: Keith William Stickle.

Southern California Section: Lloyd B. Aschenbeck, William H. Huber, John F. Maggio, William Frederick Roberts, Leslie Robert Saunders, Jr.

Southern New England Section: Clinton M. Cummings, Marshall J. McGuire, Norman Russell Meise, Lawrence M. Rogers, Richard James Wills.

Syracuse Section: William James Gorman, Jr.

Texas Section: Richard A. Flume, Jr., H. Phillip Scarborough, Jr.

Twin City Section: Gordon Volkenant.

Washington Section: Stanley R. Darcey, Milo Wesley Snider.

Wichita Section: Jerry H. Gerteis, Web W. Moore.

Williamsport Group: Charles E. Rath, Carroll S. Townsend, T. C. Tsu.

Outside of Section Territory: Berthoud C. Boulton, Max Dach, Howard W. Elser, Richard Gla Fuller, Stewart Q. Larsen, Gamaliel Milner, Leslie Moore Proctor, Roland W. Puder, Marshall Allen Ricker, Raymond B. Smith, Noel Totti, Jr., John M. Yantis.

Foreign: Thomas Alfred Beazley, England; Robert Thompson Cutler, Argentina; Clarence Ferry, Netherlands West Indies; Walter Geoffrey Hall, Australia; Joseph Jones, England; John Thomas Krycho, Brazil; Nemali Ramamurthi, South India; Hjalmar Strom, Finland; Oswaldo F. F. Torres, Brazil; George Alfred Turner, England; C. F. Wu, China.

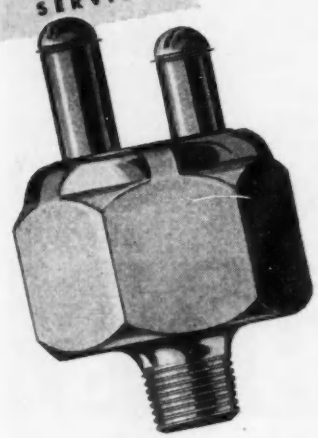
SERVICE PROVED

DOUBLE PROTECTION

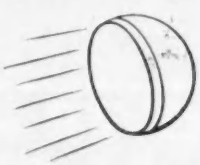
for the full life of the car

STOP

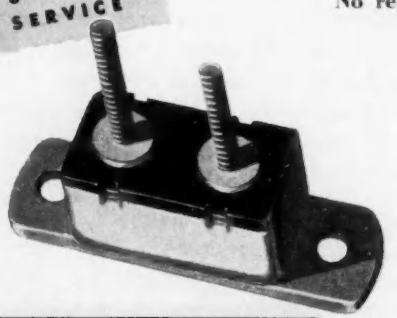
19 YEARS SERVICE



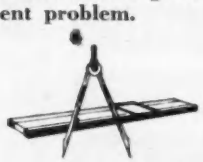
STOPLIGHT SIGNAL PROTECTION by the hydraulic stoplight switch, *originated* and made by Fasco. Standard in the automotive field since 1928. Dirtproof. Waterproof. Responds to slightest pressure change. Signals instantly and dependably. Made and tested to withstand pressure of 3000 PSI.



8 YEARS SERVICE



HEADLIGHT PROTECTION by the fast-acting, make-and-break type circuit breaker made by Fasco. Lights go off when short-circuited line gets too hot. *Automatically* go *back on* when line cools slightly. Assures enough light for safe intermittent driving. No fuse trouble. No replacement problem.



Our service-proved ability to engineer and produce electrical parts to meet highest automotive standards is available to you. Let us work with you on your electrical design and equipment problems.

PRODUCTS OF FASCO

F. A. SMITH MFG. CO., INC., ROCHESTER 2, N. Y.

Electrical Engineering and Manufacturing
Serving the Automotive Field Since 1922